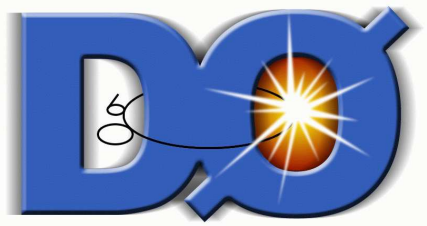
DØ Status Report

Volker Büscher

Universität Freiburg

on behalf of the DØ Collaboration

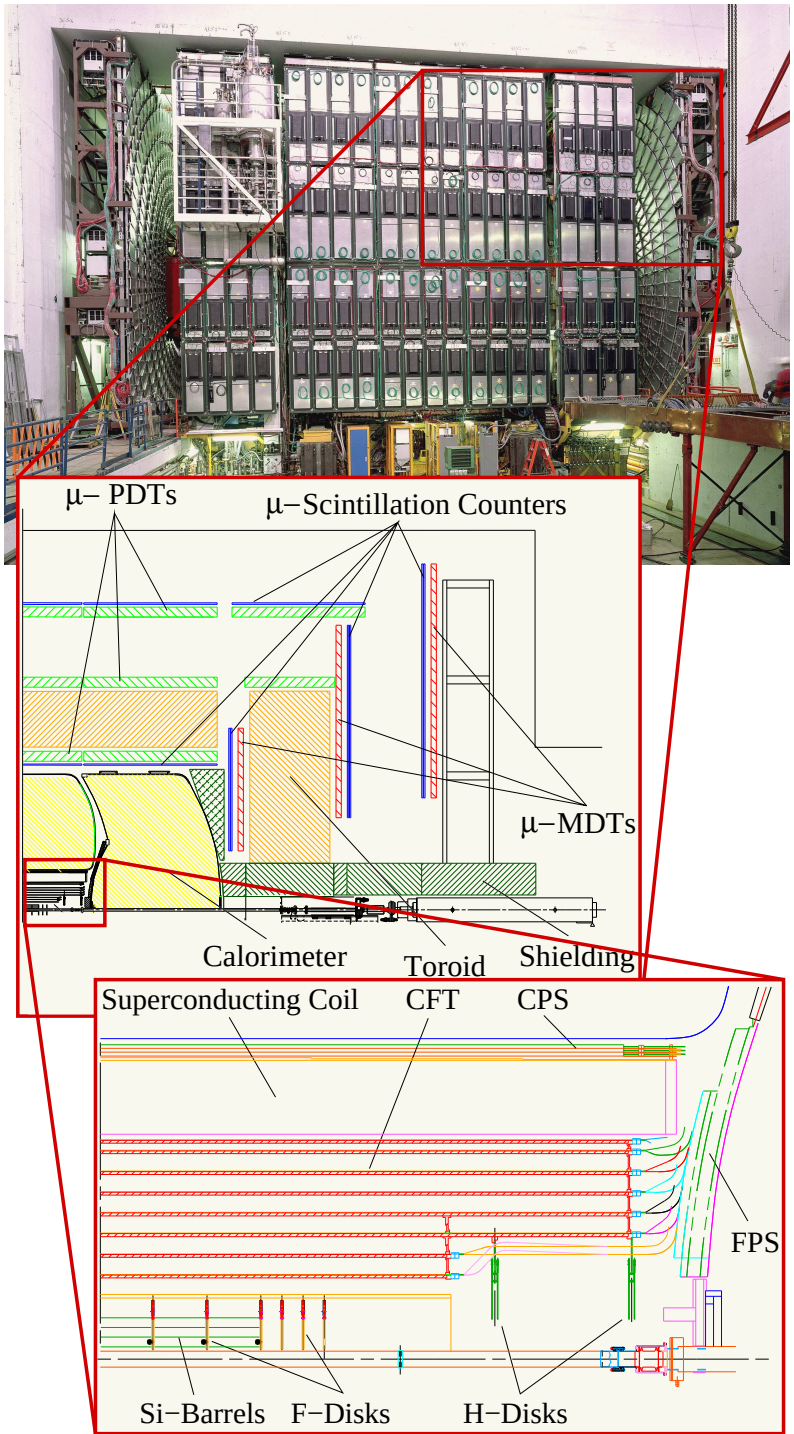


PAC Meeting, Fermilab

December 8, 2005

- Operations
- Long-Term Planning
- Upgrade Projects
- Computing and Algorithms
- Selected Physics Highlights

DØ Detector and Operations Status

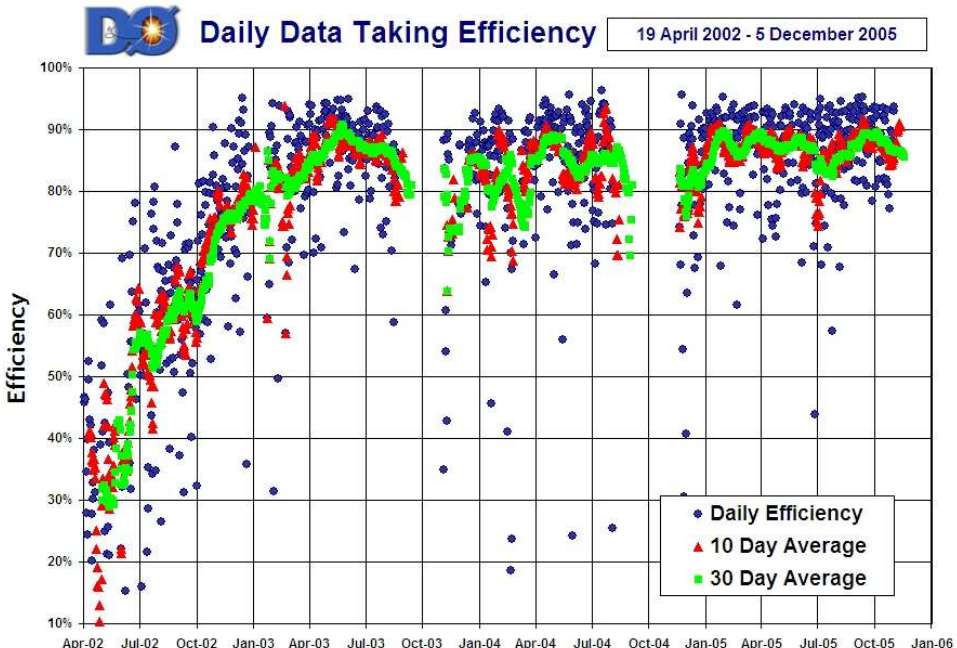


DØ: Excellent Coverage for $e, \mu, \tau, \not\!\!E_T$, b-tagging

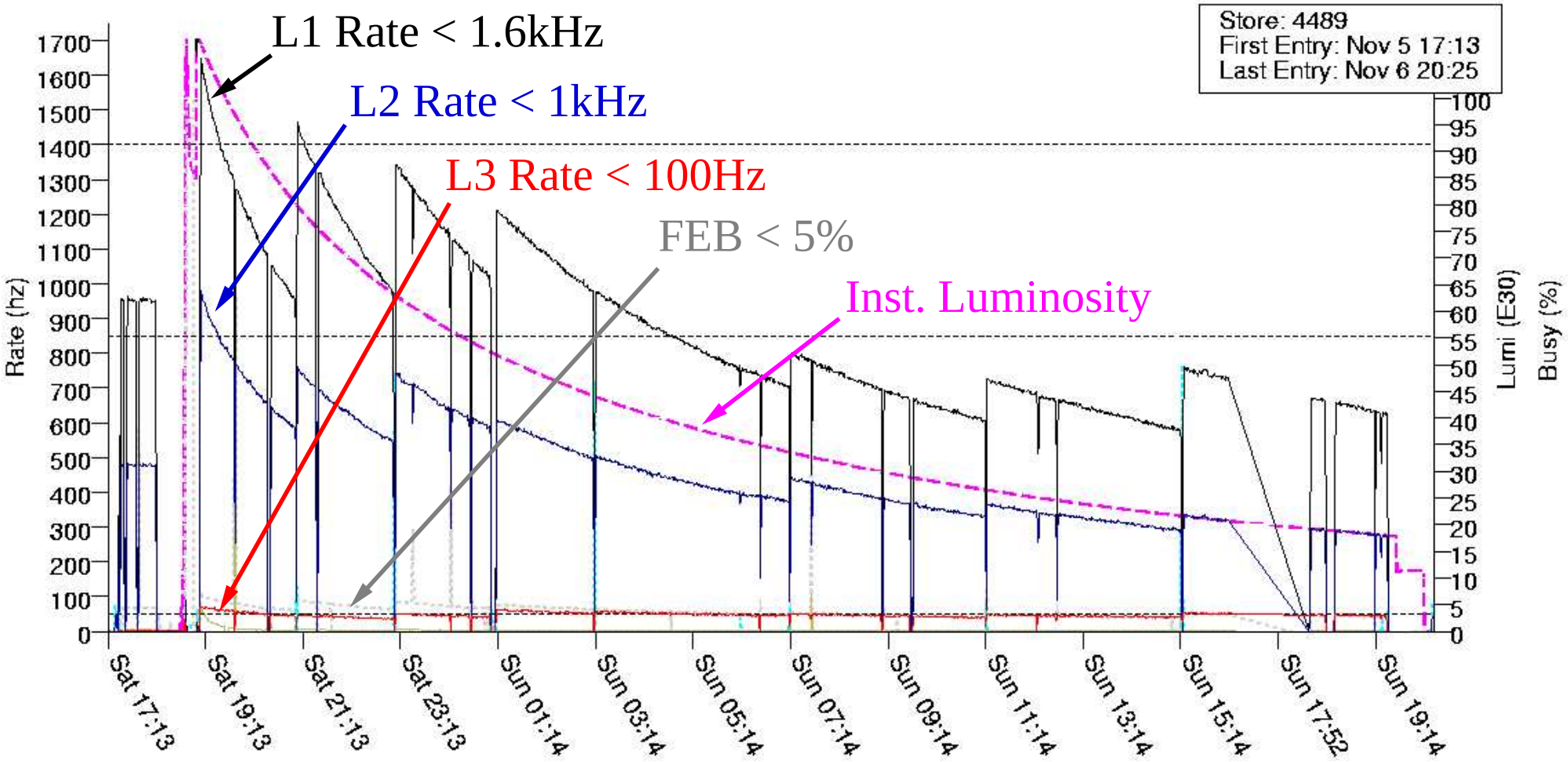
Electron acceptance	$\lvert\eta\rvert < 3.0$
Muon acceptance	$\lvert\eta\rvert < 2.0$
Silicon Precision tracking	$\lvert\eta\rvert < 3.0$
LAr Calorimeter	$\lvert\eta\rvert < 4.2$

All subdetectors continue to perform very well

- Average data-taking efficiency close to 90%
- Efficiency limited by
  - 3–5% Front-End-Busy
  - 2–3% Store and run transitions
  - <5% “incidentals”



DØ Detector and Operations Status



Improvements at Level 3: speedup of L3 reconstruction code, more farm nodes

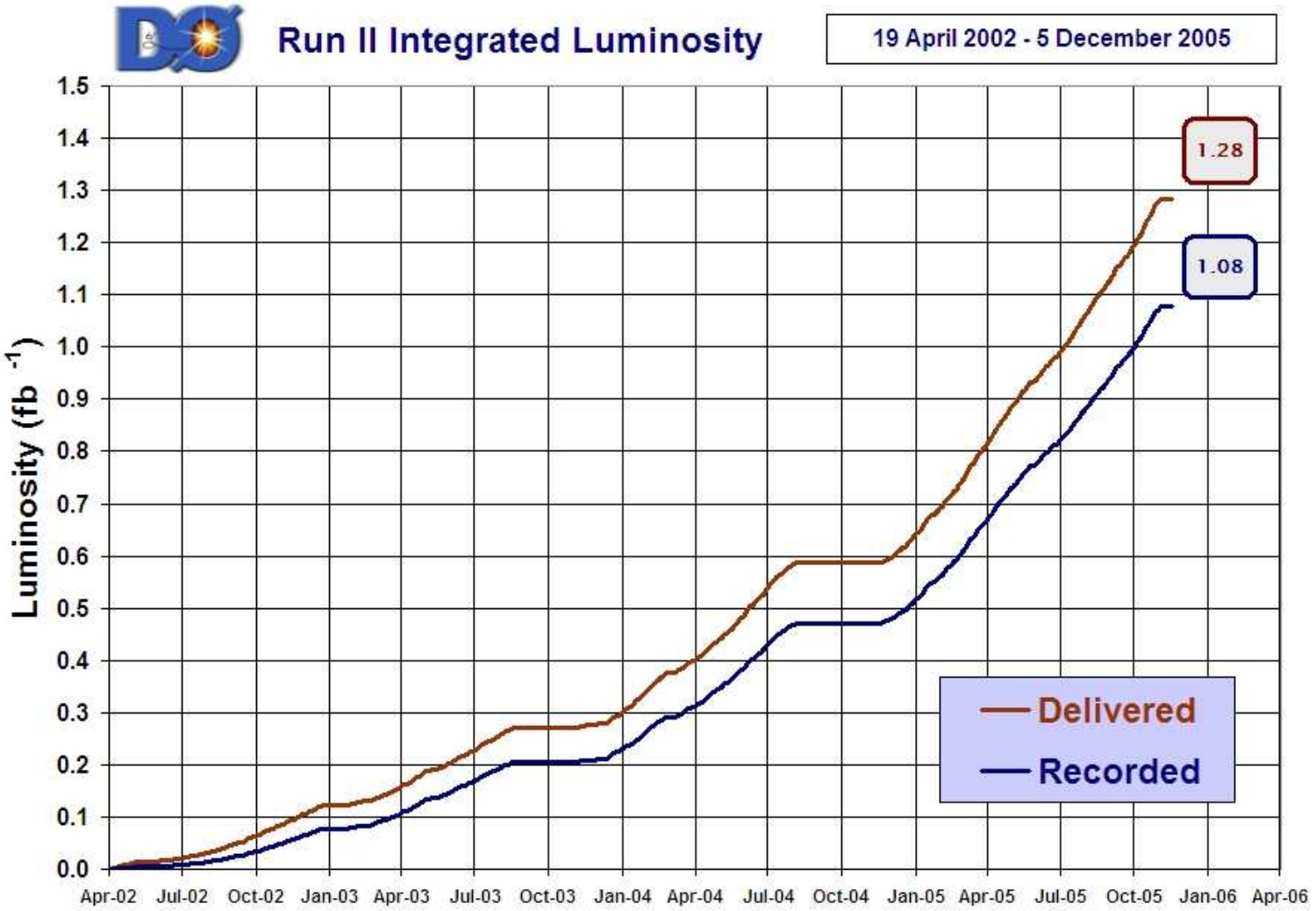
Complete menu of core triggers running up to record luminosity of 160e30

Note: non-linear behaviour of L1 rate at high luminosity

- **main reason: coarse granularity of track trigger, fake rates increase with occupancy**

DØ Run II Dataset

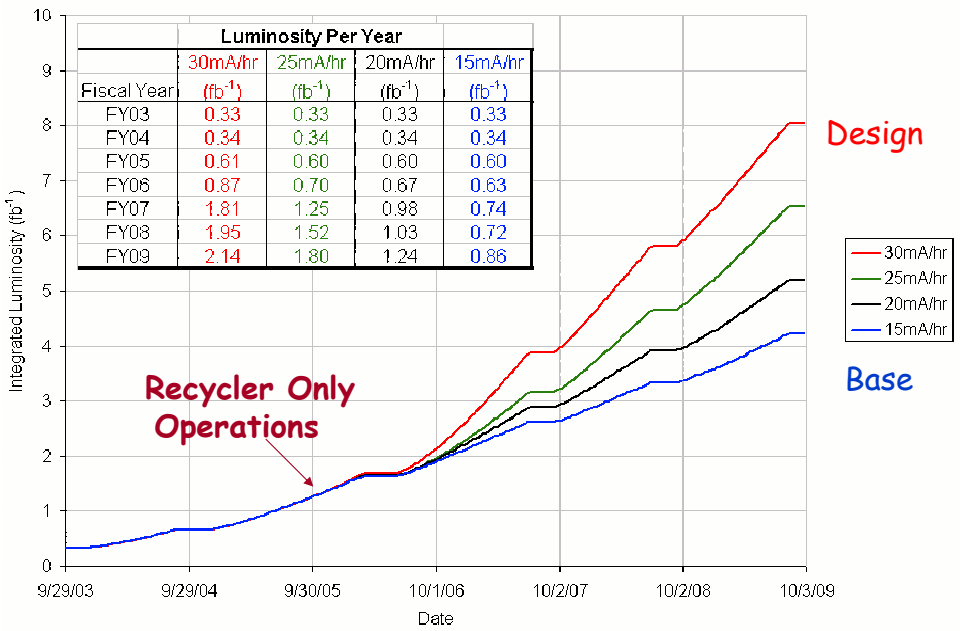
Almost 1.1 fb^{-1} on tape



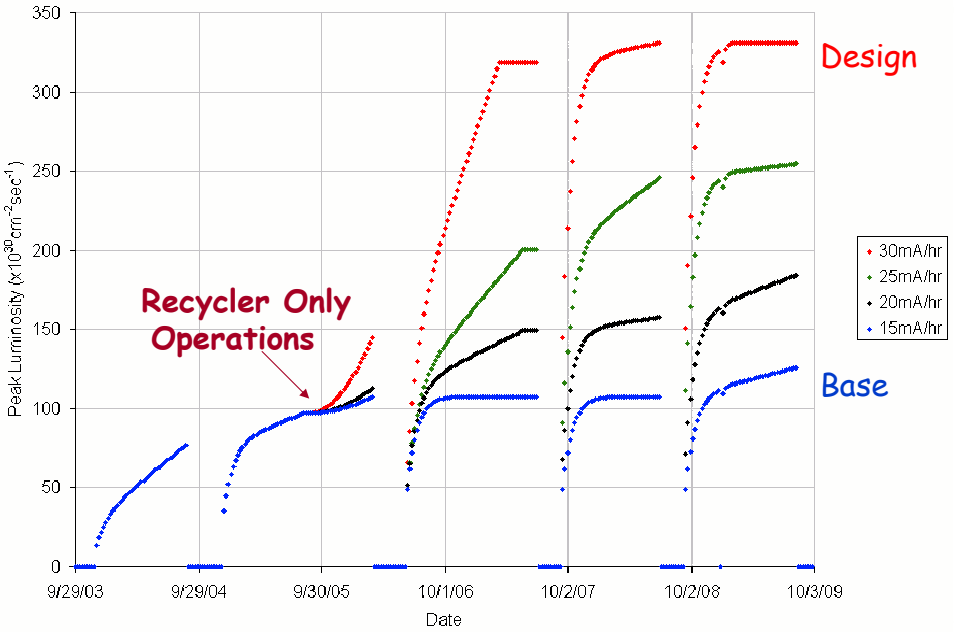
Thanks to the Accelerator Division!

Looking Forward

AD Projection of Integrated Luminosity



AD Projection of Peak Luminosity



Hoping for 4 fb^{-1} by end of 2007, 8 fb^{-1} by end of 2009

Challenging for experiment and collaboration:

- **Peak luminosities of >300e30 by early 2007**

  → Upgrade L1 Trigger

- **High radiation dose for inner layer of silicon detector**

  → Add "Layer 0" silicon detector

- **Most of the data to be delivered in parallel to LHC startup**

  → Secure manpower to operate detector + maintain Software/Computing efforts

DØ Long-term planning

Manpower analysis within the Tevatron Collider Task Force

- Bottom-up analysis of FTE needs in 2007 (after completion of upgrade)
  - detailed task-by-task projection
  - 165 FTE required for Total Service (Operations, Computing, Algorithms)
- Survey of institutional commitments for 2007
  - a total of 345 FTE committed to DØ
  - service tasks can be covered with a service fraction of 50% (!)
  - leaving about 170 FTE for physics analysis
- FTE totals clearly do not tell the whole story
- Need to ensure that all critical needs are matched by institutional commitment and expertise
- Drafts of MoUs for 2006-2007 in hand, have compared with needs task-by-task

  $\longrightarrow$ several areas of concern identified in Operations, Algorithms, Computing
- Issue is being adressed by management:
  - invest effort to achieve “steady-state” as soon as possible
  - task force recommendations to FNAL Director

Selection of DØ Goals for 2006

January 15	First approved analyses with an 1 fb^{-1}
March 5	Entire Run IIa dataset processed ($\approx$1.3 fb^{-1})
June 4	Post-shutdown triggerlist online collecting cosmics
	Re-establish data collection
June 18	Recording and evaluating reconstructed data triggered with tracks, calorimeter, and muons
June 18	First Run IIa results (1.3 fb^{-1}) submitted for publication
July 23	Routine operation of upgrade systems
August 6	Return to 85% average data logging efficiency
October 1	Full complement AFEII production boards ready
November 19	First reports on Run IIb results
December 31	Log 2 fb^{-1} to tape

Tevatron Collider Task Force Recommendations for Run II Support

Excerpts from document sent to FNAL Director

The divisions should update the laboratory staff profile required to fulfill Fermilab responsibilities to complete the Tevatron program.

Encourage the experiments and divisions to continue developing efficiencies that reduce the effective labor required to operate the Run II programs.

Continue to promote the Tevatron program to incoming Research Associates, and, starting in FY06, increase the number of CDF and DØ RA positions by two each.

Increase visitor budgets for outside personnel by approximately a factor of two.

In concert with the collaboration spokespeople, conduct negotiations with NSF, DOE, and foreign funding sources aimed at retaining or enhancing support for University resources in the areas of greatest risk.

Explore the possibility of contributions from the funding agencies for the creation of Tevatron Fellowships to support named university students (five each per experiment).

Similarly, explore the possibility of support from the funding agencies for the creation of Hadron Collider Fellowships to support post-docs (two each per experiment) resident at Fermilab. The three or four-year fellowships might initially focus on the Tevatron program with a transition to LHC occurring late in the second or early in the third year of the Fellowship.

The DØ Run IIb Upgrades

Suite of upgrades in preparation for large integrated and instantaneous luminosities

- **Tracking Upgrades:**
  - **Layer 0 Silicon Detector**
  - **Enhanced front-end boards for Central Fiber Tracker (AFE II)**
- **Trigger Upgrades:**
  - **Level 1: Central Track Trigger, Calorimeter Trigger, Cal-Track Match**
  - **Level 2: Silicon Track Trigger (Layer 0), Processor Upgrade**
- **DAQ/Online System Upgrades**

Executive Summary of Director's Review of Upgrade Installation (October 2005):

- **"Essentially ALL Hardware except AFE II is ready for installation!!!"**

  (AFE II approved this year, expected to be complete Oct 2006)
- **"The DØ Collaboration has achieved a status where they could have begun installation on October 31, 2005 as had been planned"**

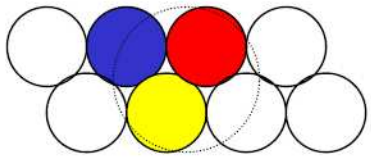
Now making best use of additional time until March 1 shutdown

- **Goal: minimize duration of post-shutdown commissioning period**

  $\rightarrow$ integrating upgrades into daily operations as much as possible

Upgrade of Level 1 Central Track Trigger

New electronics (larger FPGAs) make use of full granularity of Central Fiber Tracker



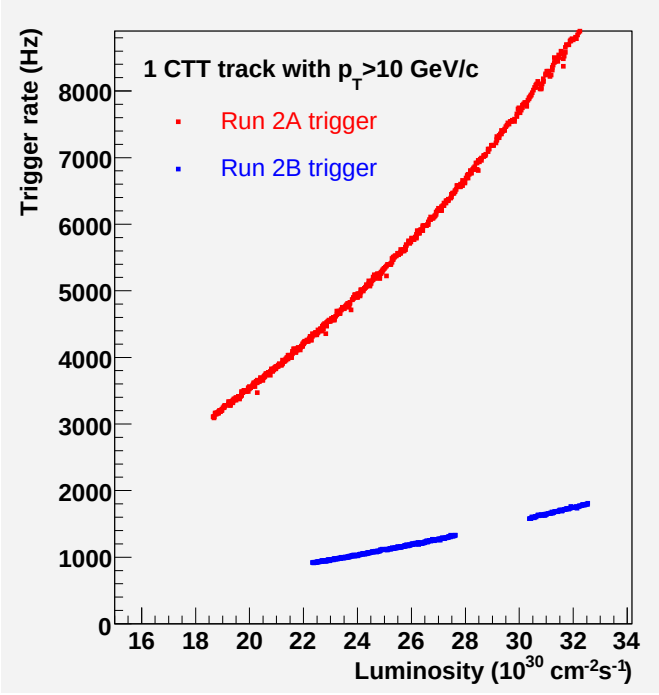
Run IIa: doublet-hits only
Run IIb: individual fibers

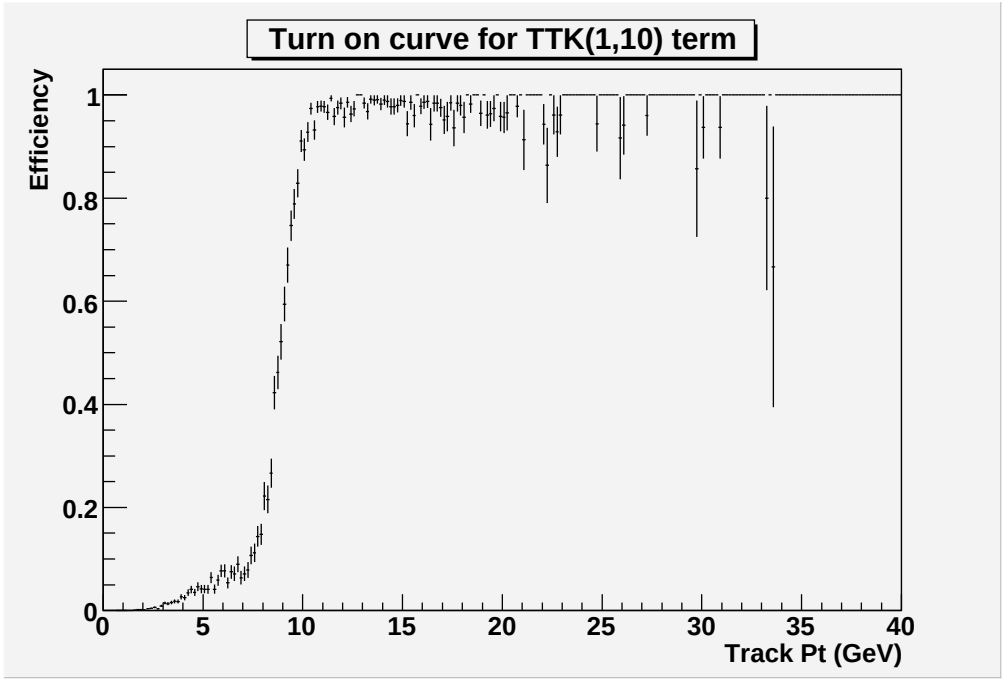
→ improved rejection of fake tracks (especially at high luminosity)

Split signals (2 sectors) into both Run IIa+b boards

- new electronics verified with real data
- testbed for new logic (plus special runs)

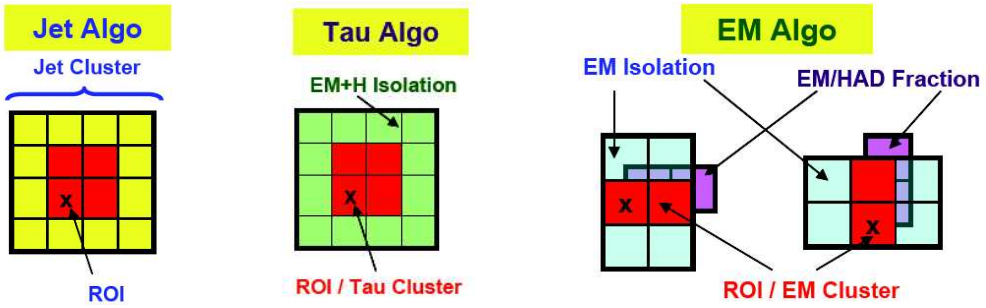
Rates and Efficiencies measured in data: significant rate reduction, efficiency ≈100%





Upgrade of Level 1 Calorimeter Trigger

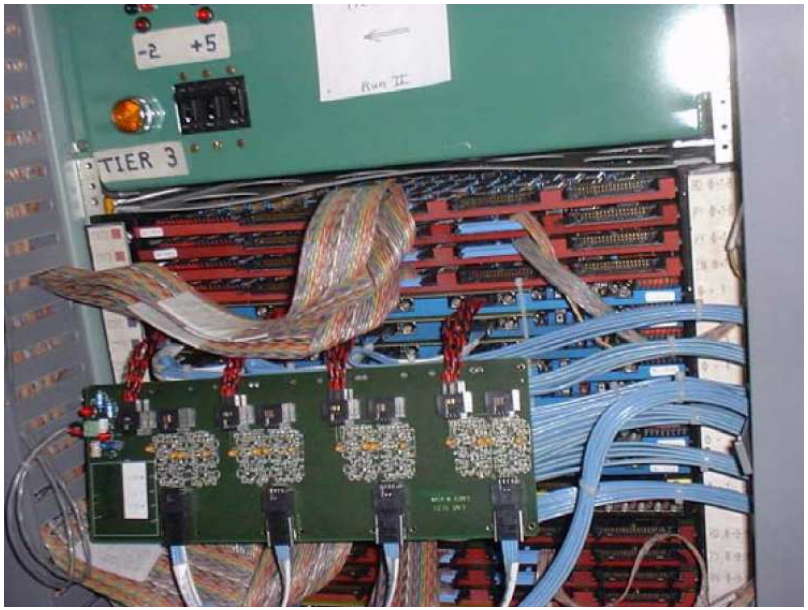
- Replacing Legacy Run I system
- New functionality: clustering algorithms (FPGA)

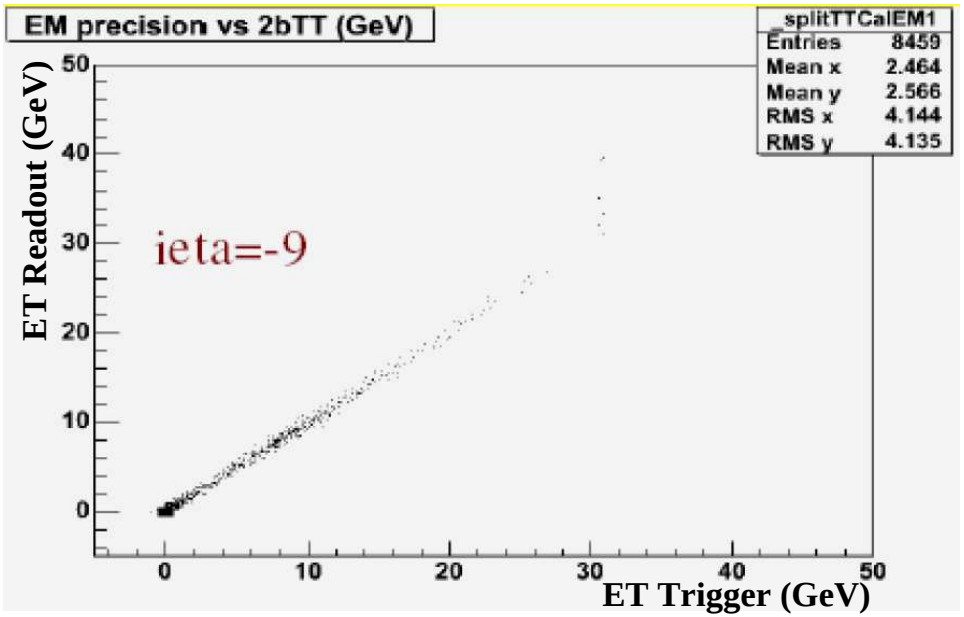


- Running with split signals (subset of trigger towers) into both Run IIa+b electronics

  → full Run IIb trigger chain established

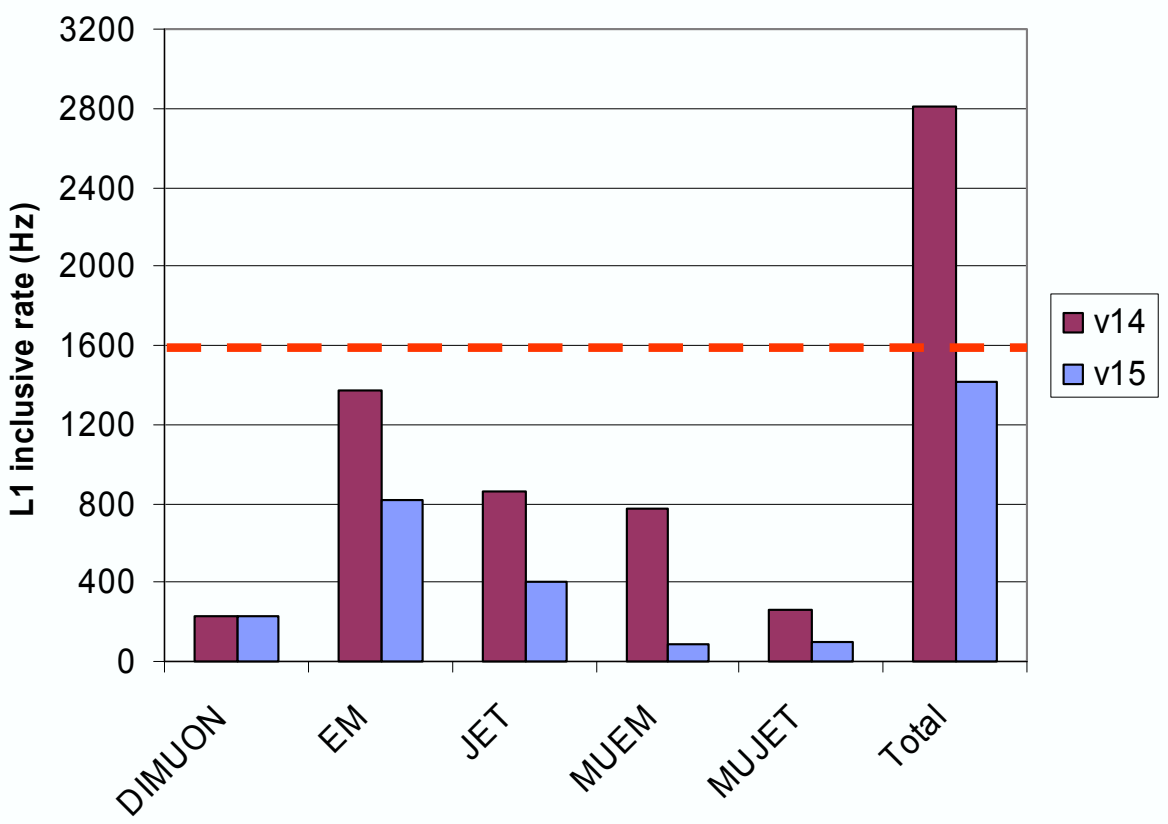
- Almost ready to operate full Run IIb system 24/7 to integrate into daily operations





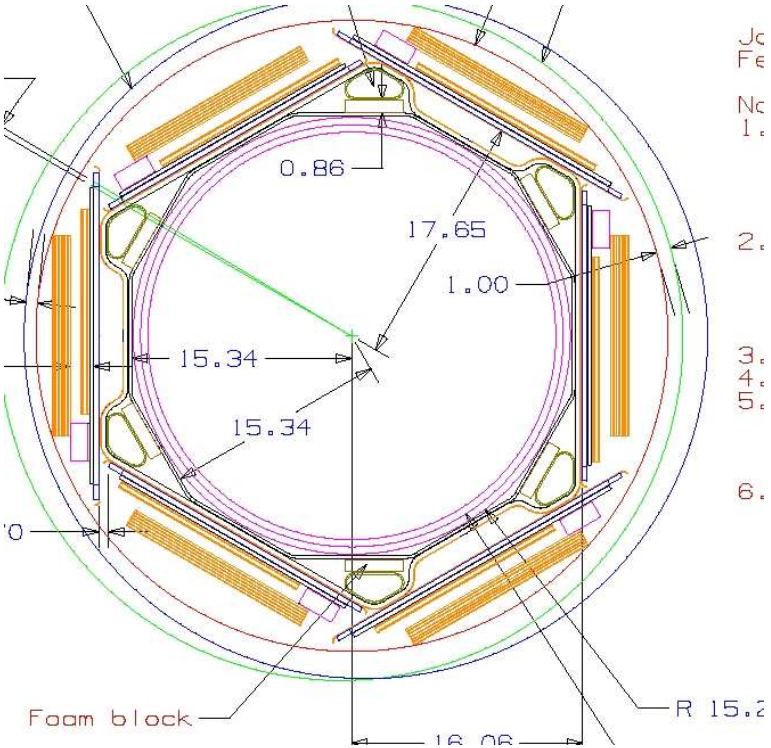
Run IIb Trigger Menu

- Functionality of upgraded triggers essentially fully implemented in trigger simulation
- L1 trigger rate at 200e30 can be reduced to < 1.6kHz with same physics menu that runs at 100e30 (no efficiency loss)



- Shutdown postponed → currently working on final Run IIb triggerlist for 300e30

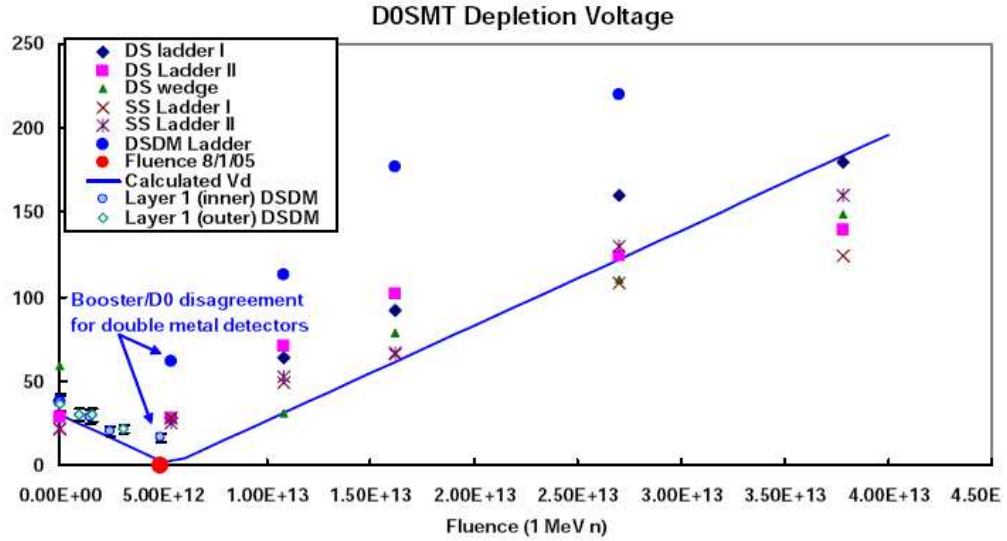
Silicon Layer 0 Upgrade

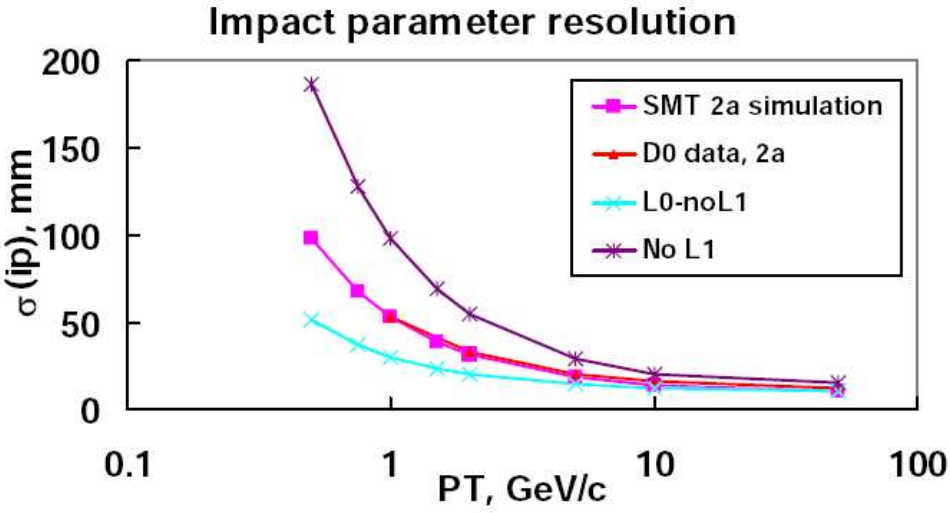


Radiation-hard silicon layer mounted between beampipe and current SMT

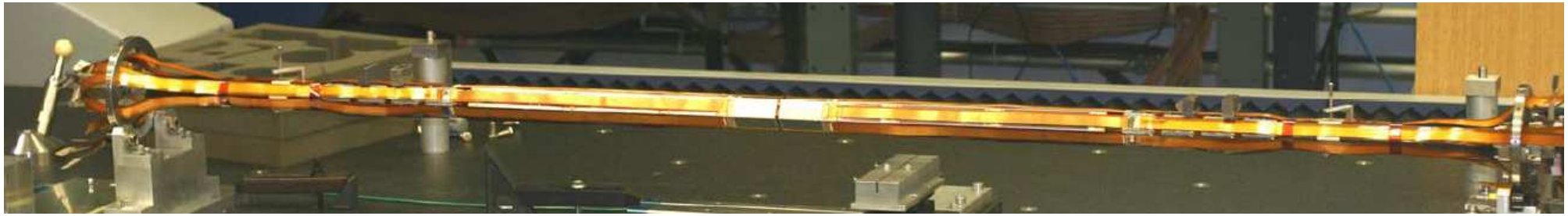
- extends lifetime of SMT
  - robustness against HDI failures
  - depletion voltage of DSDM detectors on inner layer projected to reach maximum at 5–7 fb^{-1}
- small radius+low mass

  → improved impact parameter resolution
- provides additional hit for pattern recognition

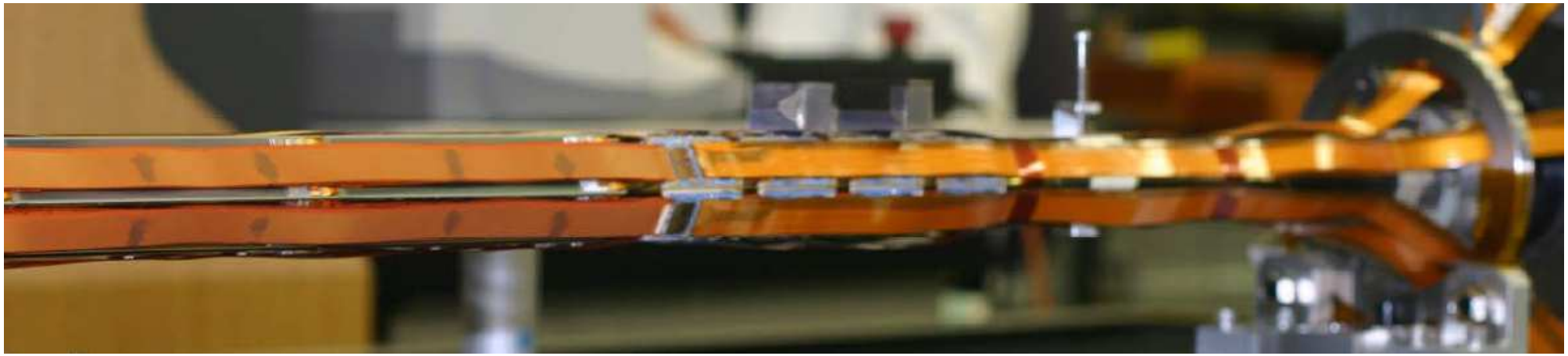




Status of Silicon Layer 0 Upgrade



- Detector complete, fully functional and ready to install!
- Final optical survey in progress



Sensors and analogue cables Hybrids Digital Cables

Layer 0 Tests and Integration

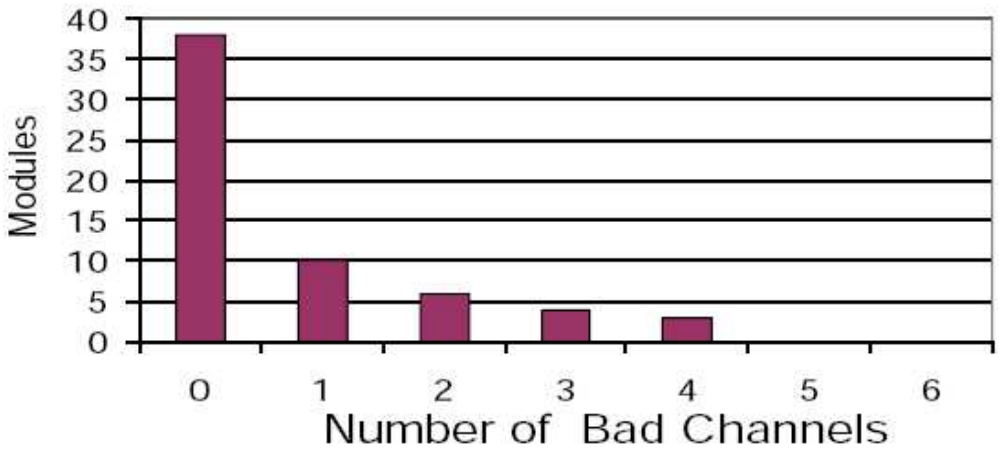
Detector performance is excellent

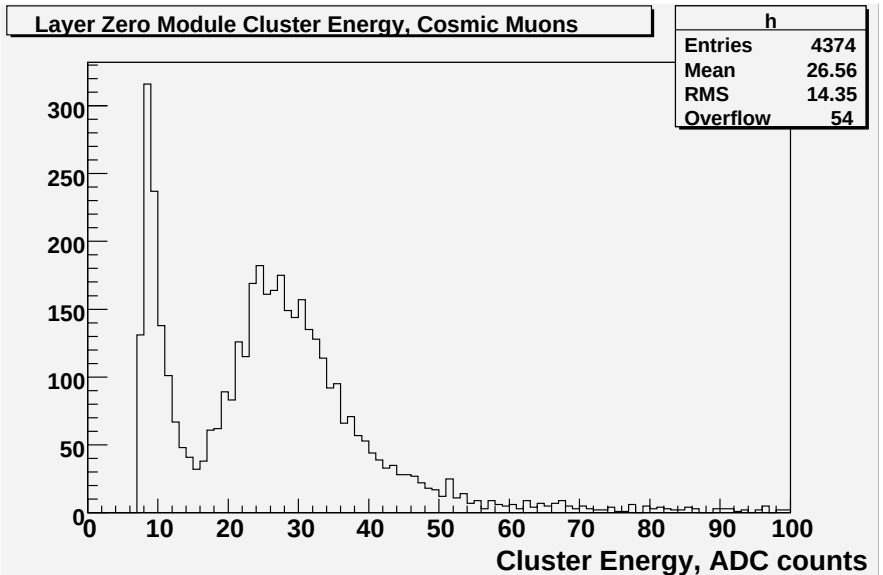
- No bad chips, $<$0.1% bad channels
- Alignment: within 2-3μm of nominal positions
- Special provisions to minimize coherent noise:

  Ground planes on support structure, low inductance strip connections to sensors and hybrids, design minimizing capacitive couplings
- Noise measurement (operating 50% of detector): 2–2.5 ADC counts
- Cosmic ray test: MIP peak at 25–30 ADC counts $\rightarrow$ S/N is larger than 10

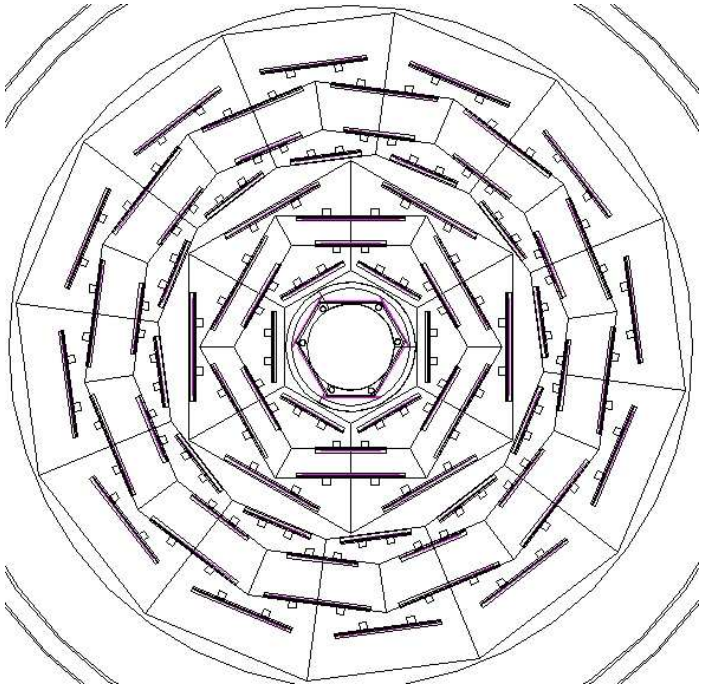
Integration into DØ Operations

- Test module in collision hall read out through full readout chain
- Now integrating monitoring tools into daily control room operations





Installation of Layer 0 Detector



"Installation" in GEANT complete

- detector and passive material in GEANT
- digitization code and reconstruction geometry ready
- incorporation of new hits into pattern recognition almost complete

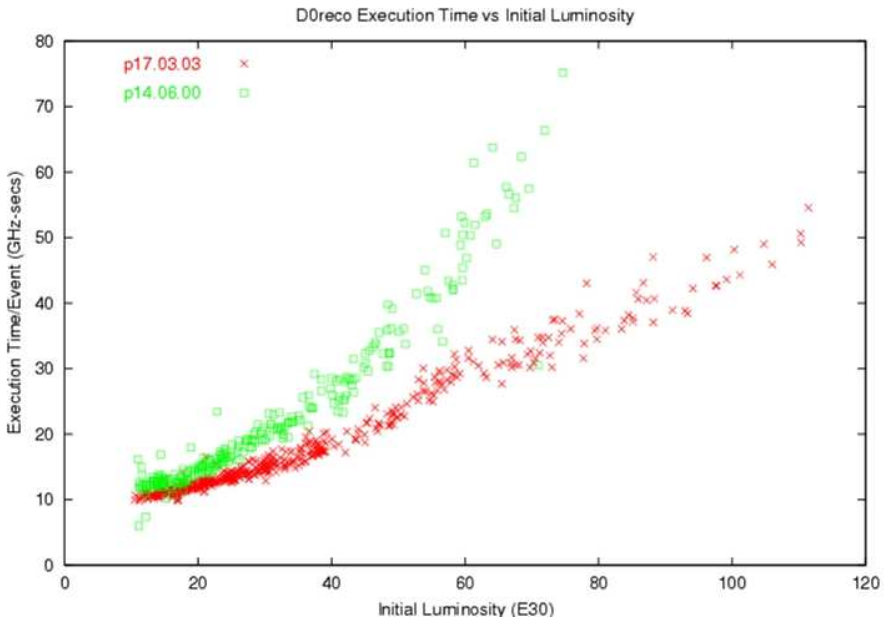
Procedure for installation in DØ in place and tested in dry runs

- proceeds through beampipe in Endcap calorimeter, then into SMT
- radial clearance less than 1 mm
- adequate tooling has been built and tested successfully with mockup detectors

DØ Computing Status

Reconstruction

- handled by farm at FNAL
- keeping up with data flow very well
- NEW: significant speed improvements (tracking), now roughly linear with inst. luminosity



Fixing

- second-pass reconstruction for improvements/corrections
- performed centrally

Skimming

- event streaming based on reconstructed physics objects
- performed centrally

Analysis

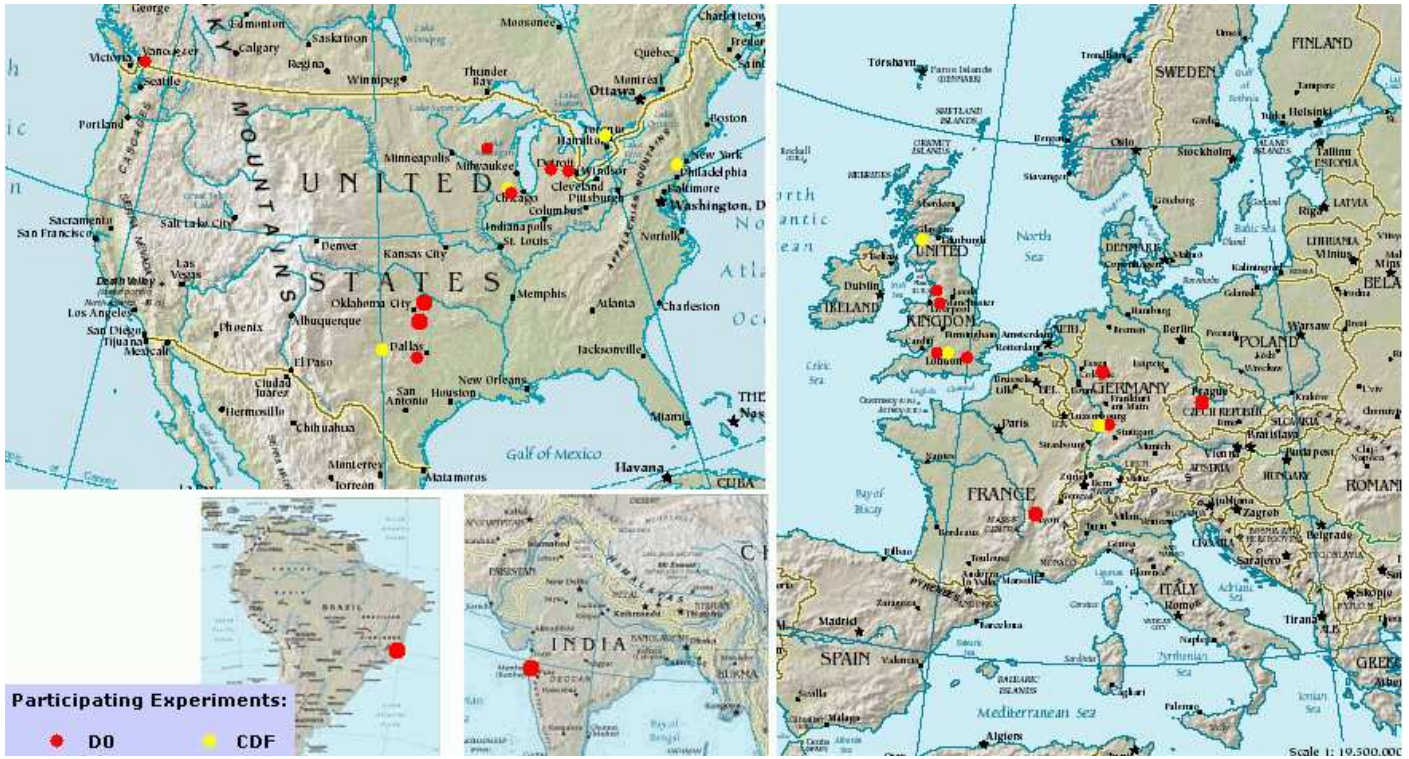
- NEW: deployed root-based Common Analysis Format (CAF) in summer 2005
- allowed sharing of analysis tools across all analyses
- transition completed in time for analysis of 1 fb^{-1} dataset

DØ World-Wide Computing

All Data-Handling via SAM ("data-grid"), 50 SAM Sites worldwide

Remote production activities via SAM-Grid:

- Monte Carlo: now producing >5M events per week
- Reprocessing: just completed reprocessing of 1B events
  - largest HEP activity on the grid
  - widely appreciated as shakedown in preparation for LHC



Total Raw Events	986190444	
Processed Events	958741259	
Sites	fnal, FNAL, OSCER, FZU_GRID, WestGrid, ccin2p3, GridKa, UTA-DPCC, Wisconsin, IMPERIAL_PRD, CMS-FNAL-WC1, SPRACE	

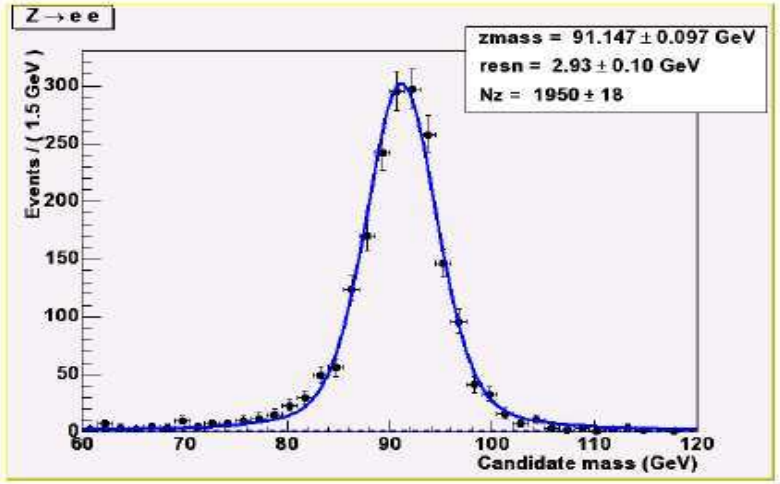
The 1 fb^{-1} Dataset

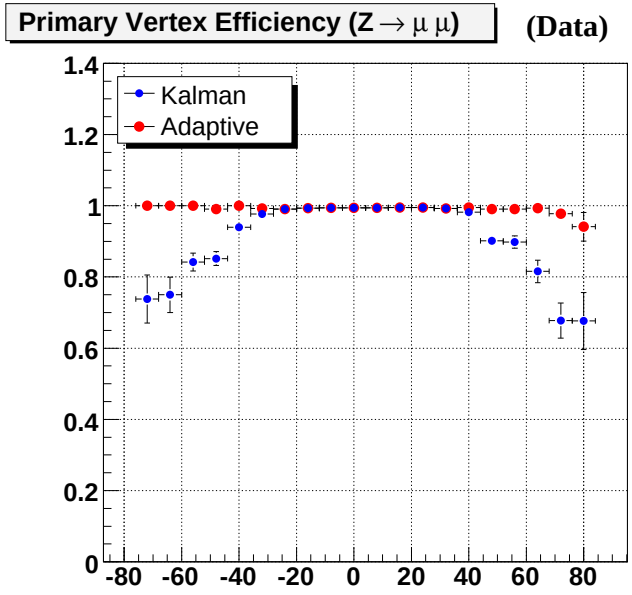
Reprocessing and Fixing of 1 fb^{-1} dataset complete

→ uniform dataset with latest calibration and algorithm improvements in hand

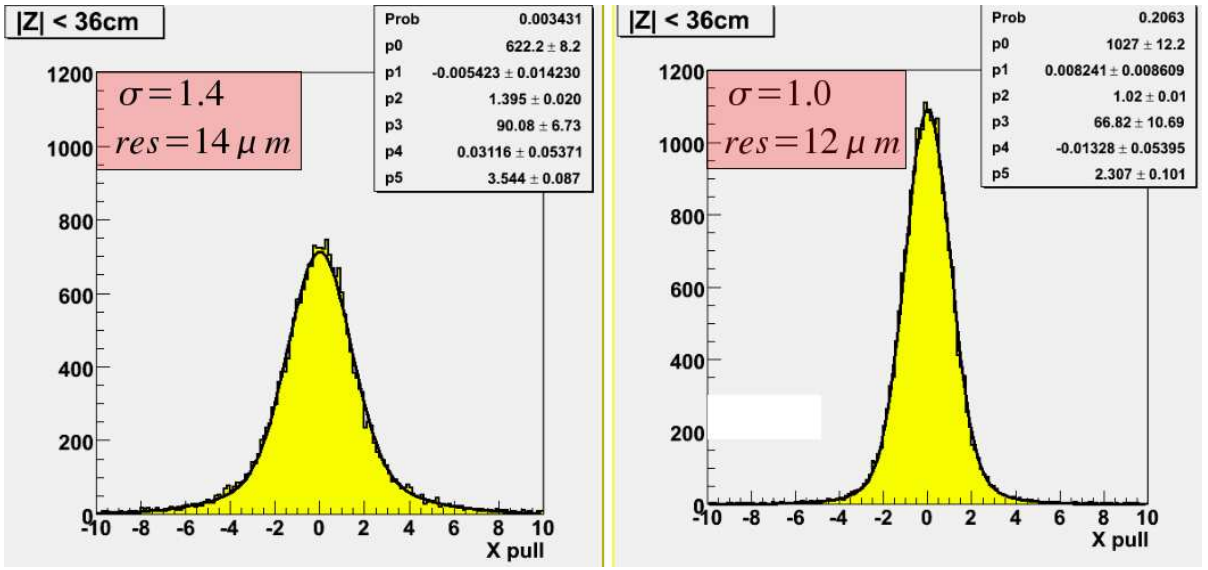
Examples of key low-level improvements:

- **Improved energy resolution**
  (width of Z→ee peak improved by 13%)
- **Vertex eff. now ≈100% out to $|z|$=80 cm**
- **Better vertex resolution, smaller tails**
  → b-tagging significantly improved



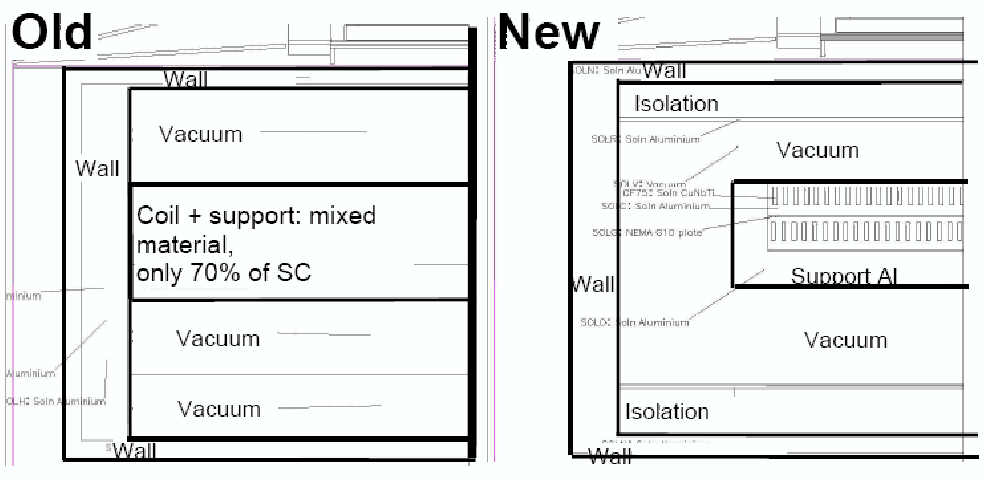


Pull distribution in $Z \rightarrow b\bar{b}$ MC for old (left) and new (right) vertexing

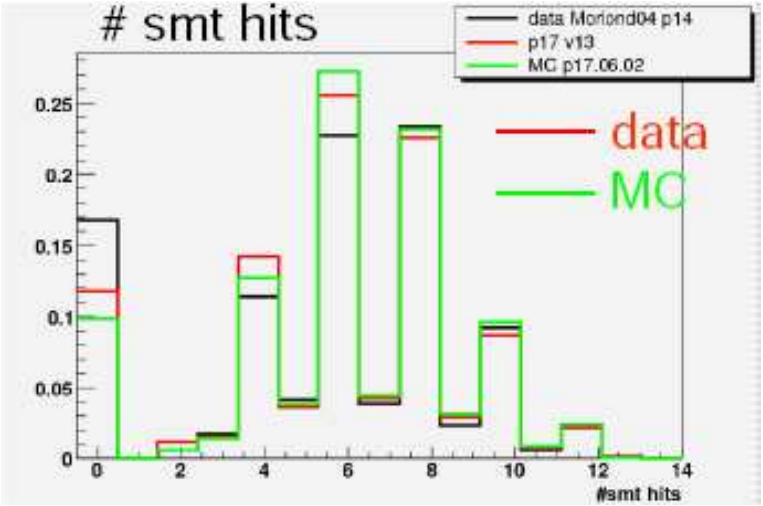


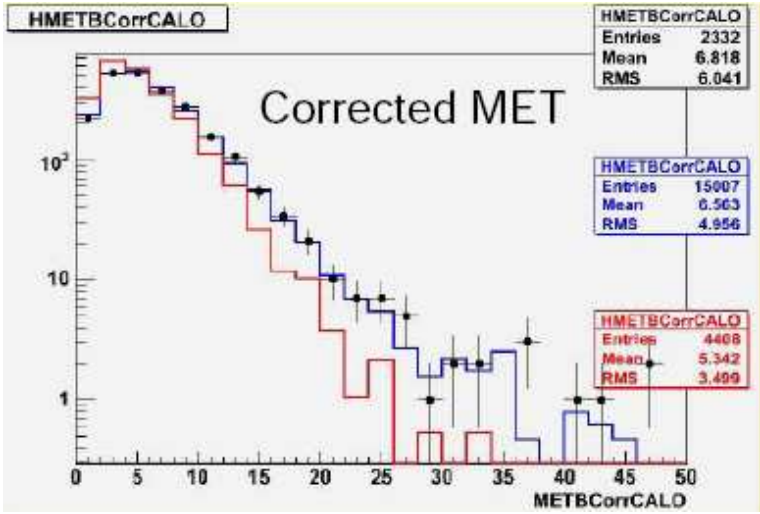
MC Improvements for 1 fb^{-1} Analyses

- Enhanced detail of GEANT geometry:
  coil windings, cooling pipes, SMT electronics and cabling...



- Simulating dead channels in tracking detectors, averaged over 1 fb^{-1} dataset
- Using overlay of zero-bias data for modelling of detector noise, multiple interactions





DØ Run II Publications (accepted/submitted)

1. Search for Doubly-charged Higgs Boson Pair Production in the Decay to mu+mu+mu-mu- in pbarp Collisions at sqrt(s)=1.96 TeV
2. Observation and Properties of the X(3872) Decaying to J/psi pi+pi- in pbarp Collisions at sqrt(s)=1.96 TeV
3. Search for Supersymmetry with Gauge-Mediated Breaking in Diphoton Events at DZero
4. Measurement of Dijet Azimuthal Decorrelations at Central Rapidities in pbarp Collisions at sqrt(s)=1.96 TeV
5. Measurement of the B_s^0 Lifetime in the Exclusive Decay Channel $B_s^0 \rightarrow$J/psi phi
6. A Search for the Flavor-Changing Neutral Current Decay $B_s^0 \rightarrow$mu+ mu- in pbarp Collisions at sqrt(s)=1.96 TeV
7. Measurement of the Ratio of B+ and B0 Meson Lifetimes
8. Measurement of the Lambda-B Lifetime in the Decay Lambda-B $\rightarrow$ J/psi Lambda With the D0 Detector
9. A Search for Wbb and WH Production in pbarp Collisions at sqrt(s)=1.96 TeV
10. Measurement of the WW Production Cross Section in pbarp Collisions at sqrt(s)=1.96 TeV
11. A Measurement of the Ratio of Inclusive Cross Sections pbarp$\rightarrow$Zb/pbarp$\rightarrow$Zj at sqrt(s)=1.96 TeV
12. A search for anomalous heavy-flavor quark production in association with W bosons
13. First measurement of sigma(ppbar$\rightarrow$Z)xBr(Z$\rightarrow$tau tau) at sqrt(s)=1.96 TeV
14. Search for first-generation scalar leptoquarks in ppbar collisions at sqrt(s)=1.96 TeV
15. Study of Zgamma events and limits on anomalous ZZgamma and Zgammagamma couplings in pbarp collisions at sqrt(s)=1.96 TeV
16. Measurement of inclusive differential cross sections for Upsilon(1S) production in ppbar collisions at sqrt(s)=1.96 TeV
17. Measurement of the p-barp $\rightarrow$ Wgamma +X Cross section and Limits on Anomalous WWgamma Couplings at sqrt(s)=1.96 TeV
18. Production of WZ Events in p-barp Collisions at sqrt(s)=1.96 TeV and Limits on Anomalous WWZ Couplings
19. Search for neutral supersymmetric Higgs bosons in multijet events at sqrt(s)=1.96 TeV
20. Measurement of the ttbar cross section in $p\bar{p}$ collisions at sqrt(s)=1.96 TeV using kinematic characteristics of lepton plus jets events
21. Measurement of the ttbar cross section in pbarp collisions at sqrt(s)=1.96 TeV using lepton plus jets events with lifetime b-tagging
22. Search for supersymmetry via associated production of charginos and neutralinos in final states with three leptons
23. Search for Randall-Sundrum Gravitons in Dilepton and Diphoton Final States
24. Search for right-handed W bosons in top quark decay
25. Search for single top quark production in pbarp collisions at sqrt(s)=1.96 TeV
26. Measurement of the ttbar production cross section in pbarp collisions at sqrt(s)=1.96 TeV in dilepton final states
27. Search for large extra spatial dimensions in dimuon production at DZero
28. Measurement of semileptonic branching fractions of B mesons to narrow D** states
29. Measurement of the lifetime difference in the Bs system
30. Search for the Higgs Boson in H$\rightarrow$WW(*) Decays in pbarp Collisions at sqrt(s) = 1.96 TeV
31. The Upgraded D0 Detector
32. Measurements of the isolated photon cross section in pbarp Collisions at sqrt(s) = 1.96 TeV

32 Publications plus 9 in final stages of review

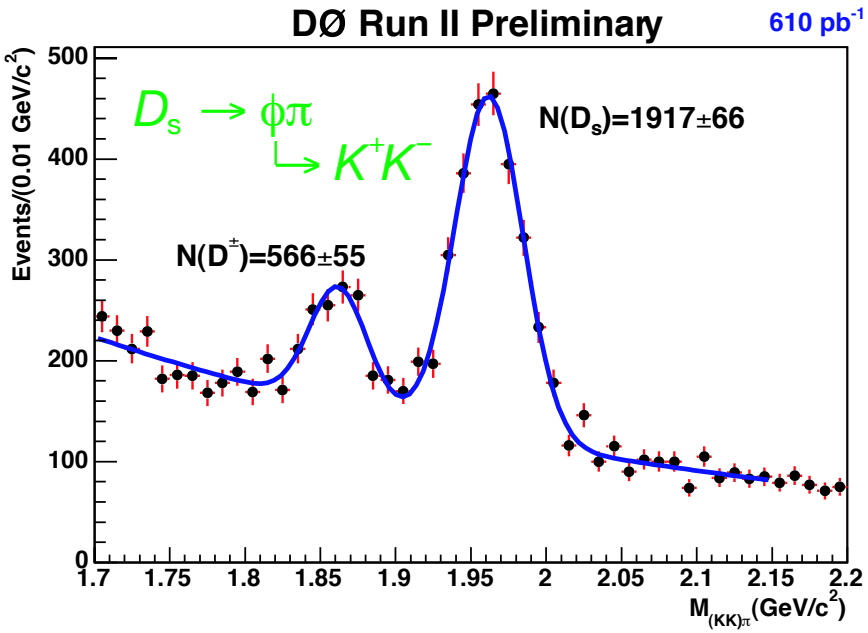
62 Conference Results

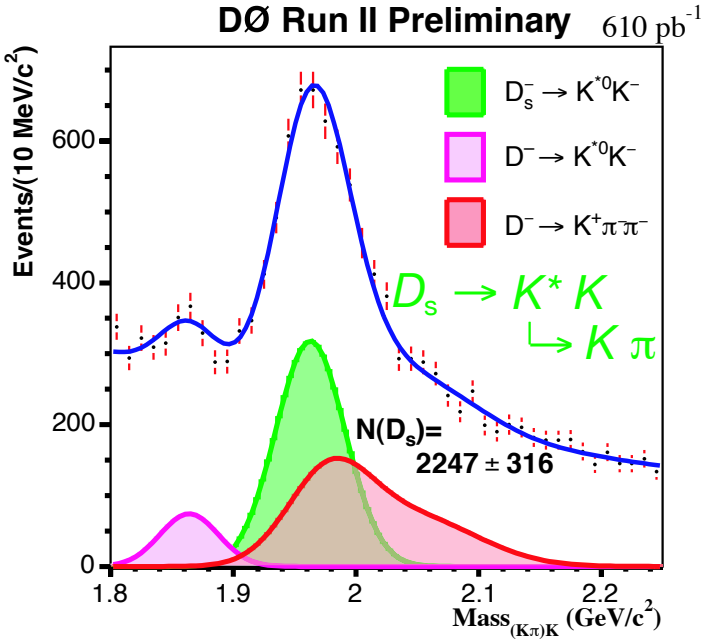
Physics Highlights: B_s Mixing

Inclusive single muon triggers down to p_T >3 for $|\eta| < 2.0$

→ **Large sample of flavor-tagged semi-leptonic B_s candidates (0.61 fb^{-1}):**

about 4200 $B_s \to D_s \mu X$ with $D_s \to \Phi\pi$ and $D_s \to K^*K$ (34k before tagging)



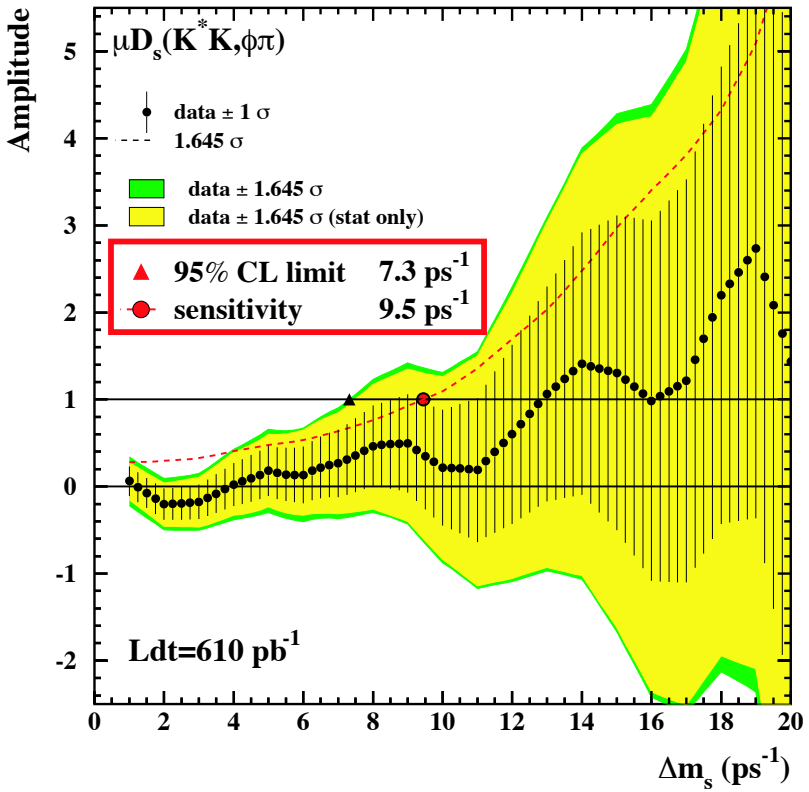


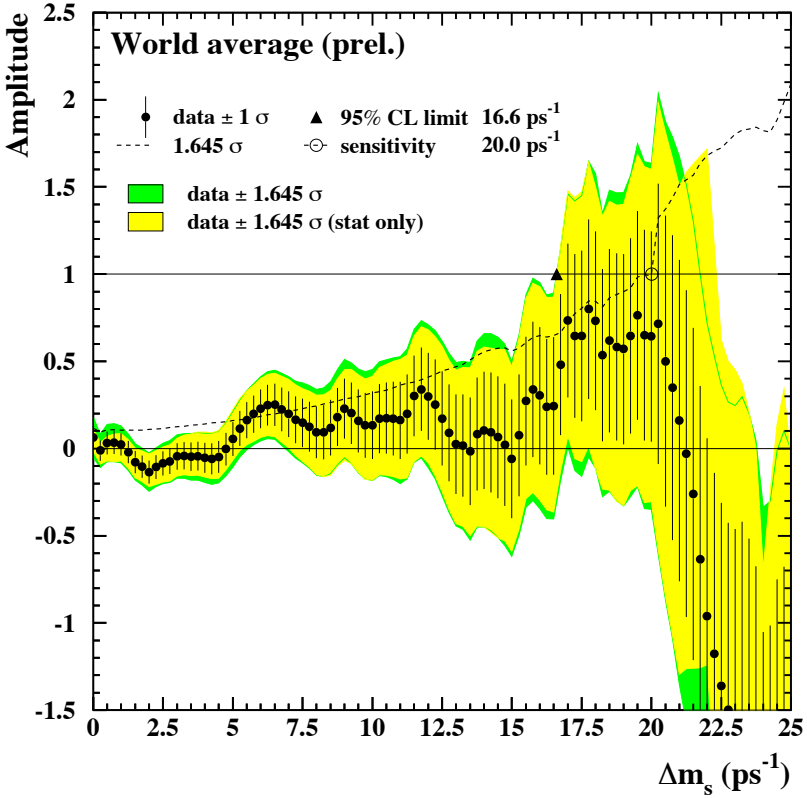
Opposite-side flavor tagging:

- **Muon or electron, jet charge, secondary vertex charge and p_T, event charge**
- **all combined into single likelihood ratio: $\epsilon D^2 = (1.94 \pm 0.14 \pm 0.09)$ %**

Reminder: Significance = $\sqrt{\frac{S\ \epsilon D^2}{2}} e^{-0.5(\Delta m_s \sigma_t)^2} \sqrt{\frac{S}{S+B}}$

B_s Mixing Results





Numerous improvements in the pipeline:

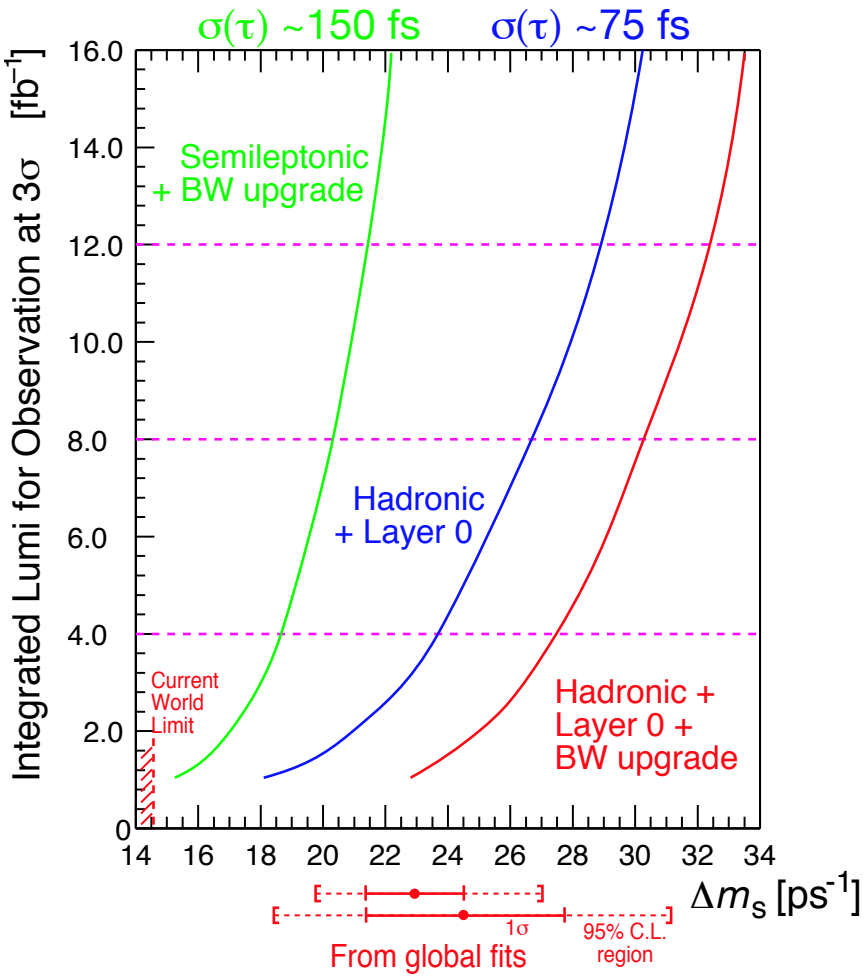
- more channels: D_s plus electron (signal in hand)
- refined flavor tagging
- use event-by-event dilution for limit setting
- unbinned amplitude fit
- more statistics

Expecting sensitivity between 12 and 14 ps^{-1} in 1 fb^{-1} from D_s+lepton alone

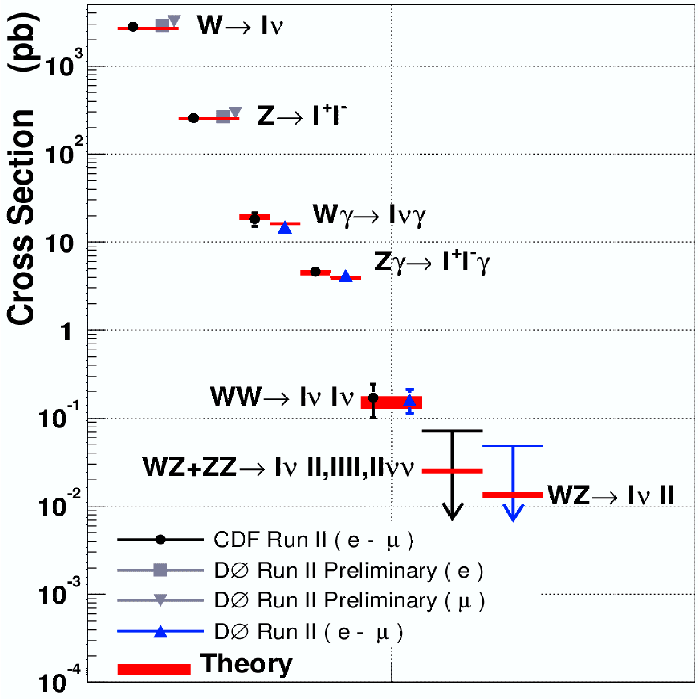
B_s Mixing Run IIb Projections

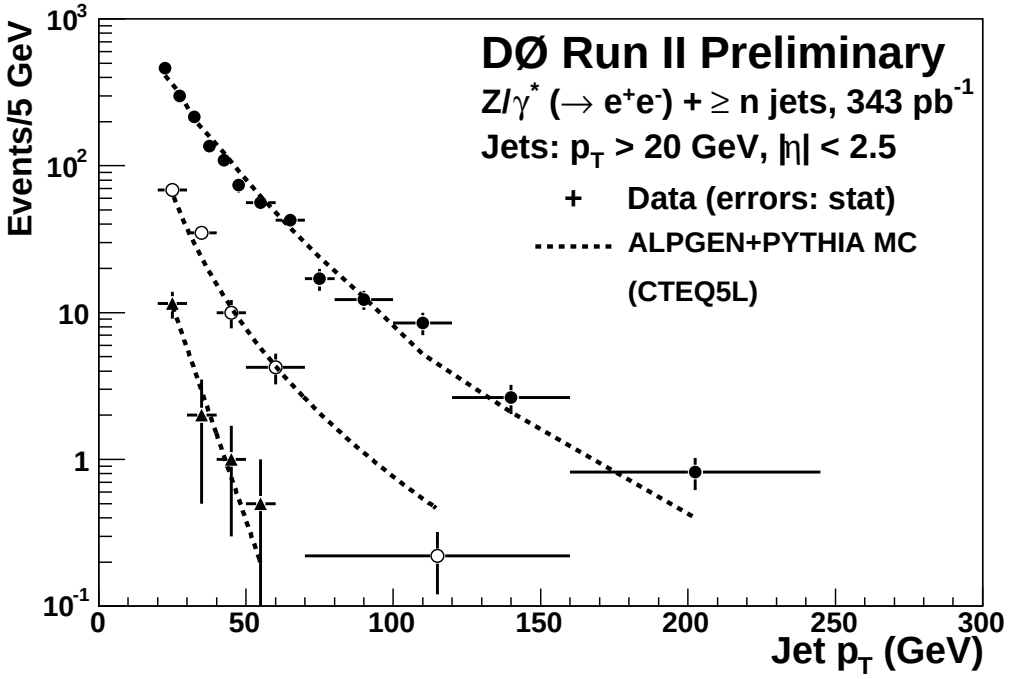
Expecting to extend sensitivity well beyond Standard Model prediction

- will require inclusion of hadronic channels (in progress)
- Layer 0 Upgrade will improve VPDL resolution
- Securing computing resources to reconstruct additional 50 Hz dedicated to B physics
  - request for funding from IU and UO pending approval
  - recommissioning retired farms from FNAL and UO



"Bread and Butter" Physics





Results available for full set of EW processes

- important backgrounds to rare signals at Tevatron and LHC
- studying (differential) cross sections, asymmetries to extract information on PDFs, anomalous couplings etc.

Example: W/Z+jets production

- major background to Top and Higgs signals
- several new generators on the market: alpgen, CKKW-Pythia, Sherpa
- first results available for alpgen, more to follow soon
- working in close collaboration with theorists

Measurement of the W mass

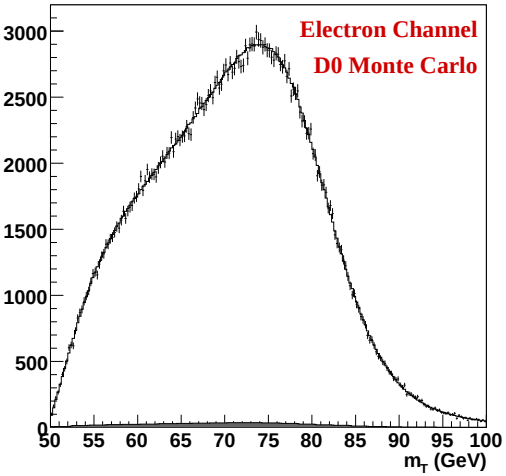
Analysis in progress, no approved results available yet

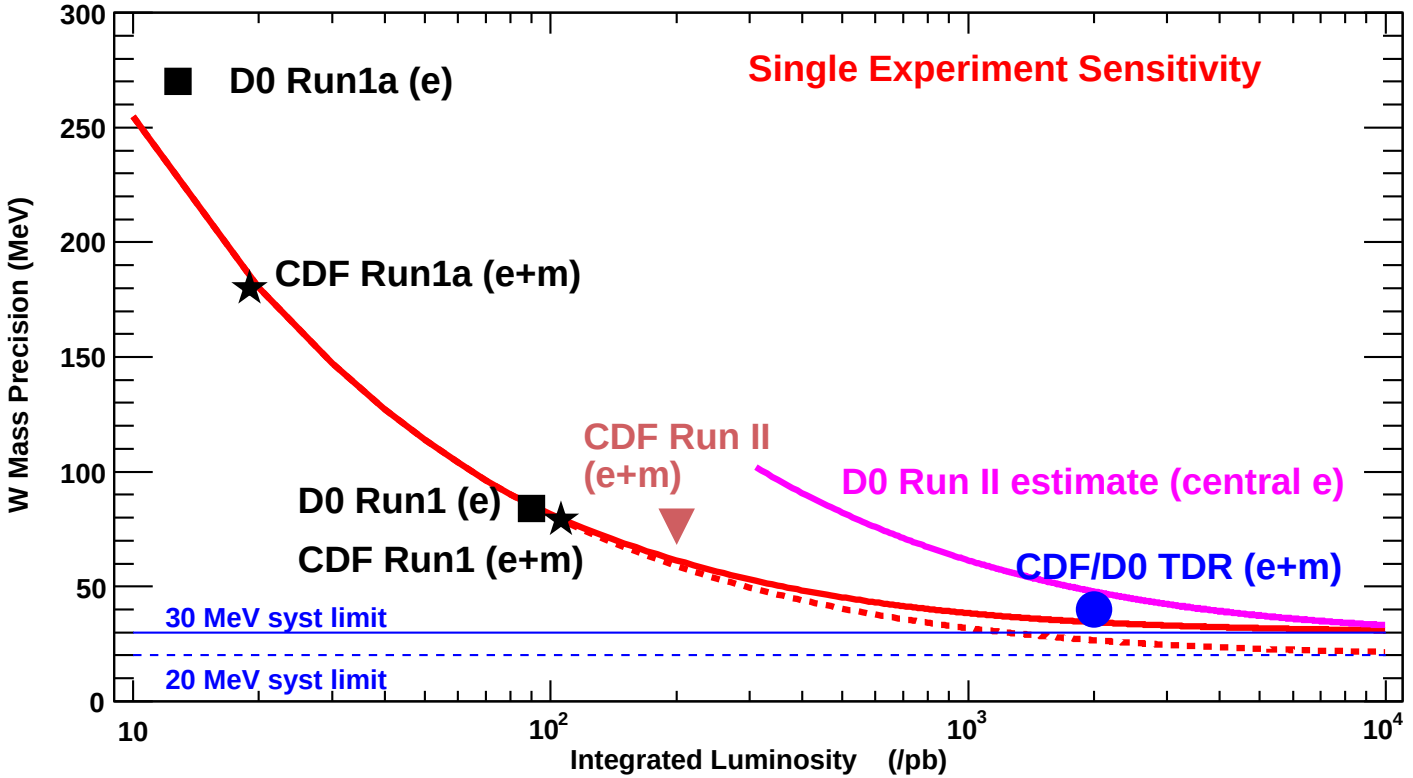
- last pass at calorimeter calibration and new improved MC provide solid basis for high-precision results

Current DØ estimates for uncertainty on m_W (stat+syst):

- From M_T Fit, central electrons only, 200 pb^{-1}: $\pm$120 MeV
- Extrapolation to 2 fb^{-1}: $\pm$48 MeV

  (Error dominated by electron energy scale uncertainties)





The Search for Single Top Production

Single top cross section: direct measurement of V_{tb}

Winter 2005 publication (230 pb^{-1}):

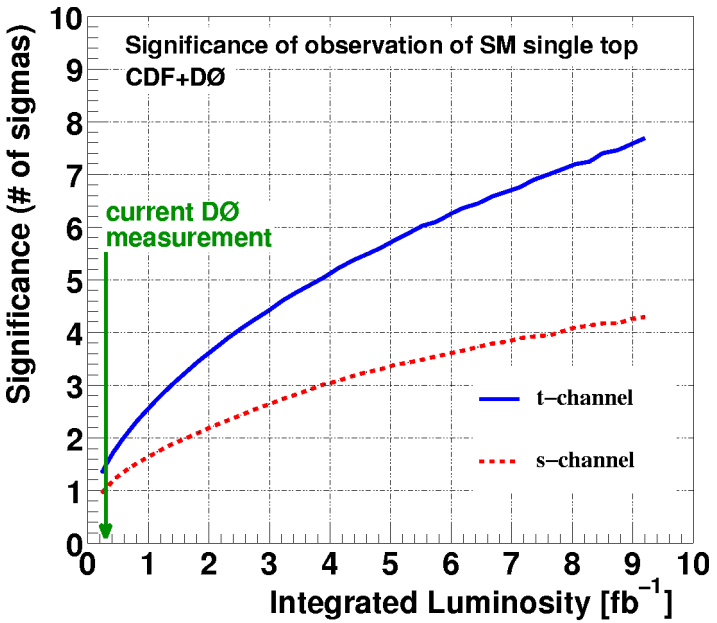
- **s-channel: σ <6.4 pb (expected: 4.5 pb)**
- **t-channel: σ <5.0 pb (expected: 5.8 pb)**

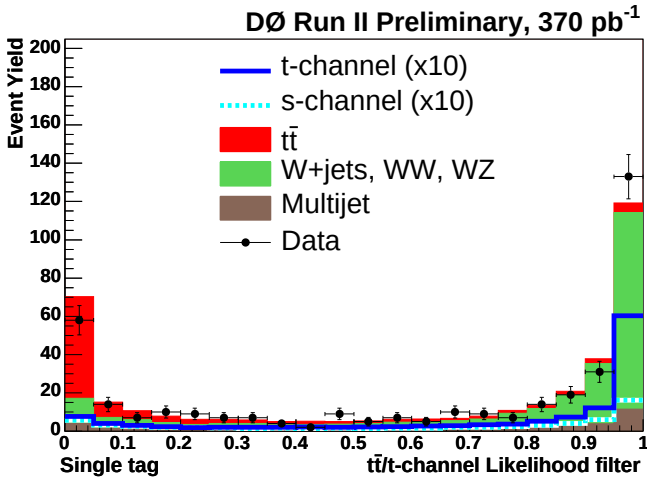
Summer 2005 prel. (370 pb^{-1}):

- **s-channel: σ <5.0 pb (expected: 3.3 pb)**
- **t-channel: σ <4.4 pb (expected: 4.3 pb)**

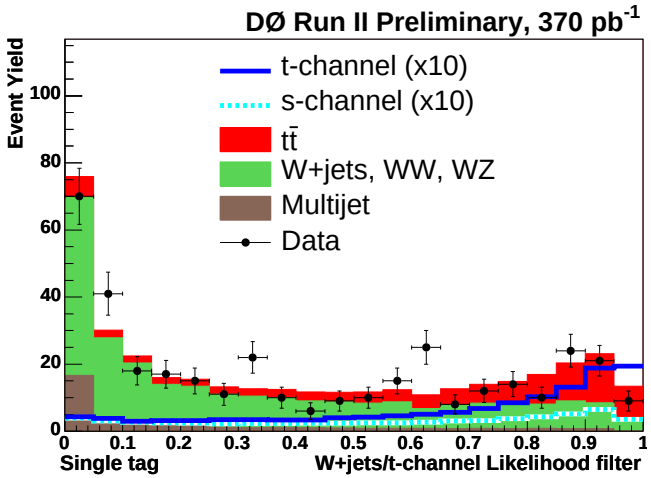
1 fb^{-1} analysis in preparation for Moriond

Expect to achieve 3σ sensitivity by summer





Discriminant against $t\bar{t}$



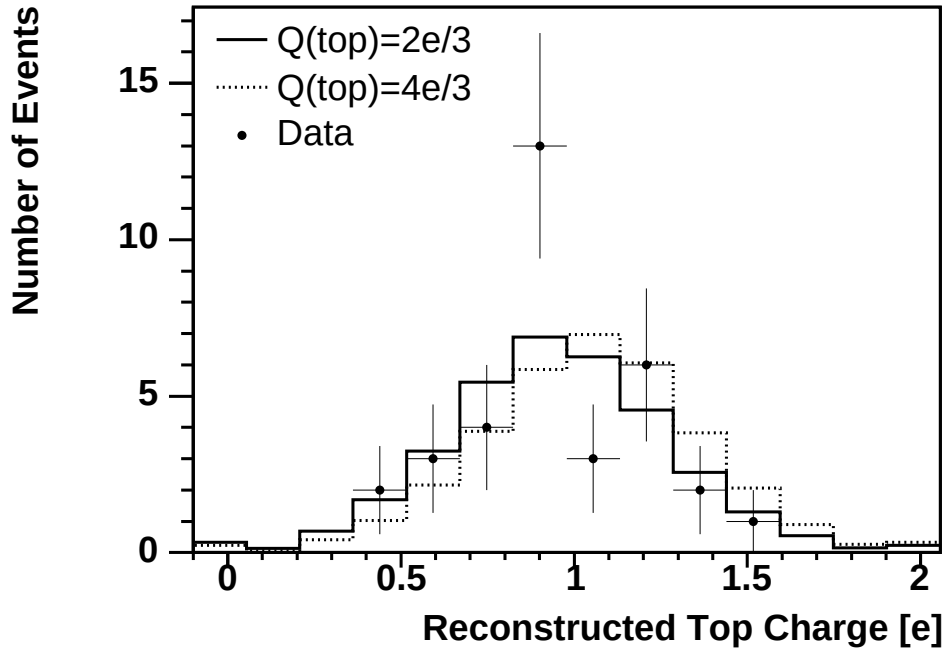
Discriminant against W+jets

Properties of the Top Quark

Towards measurements of the complete set of quantum numbers

Top Charge: preliminary results sent to PANIC 2005

– Charge consistent with $2/3e$, $4/3e$ excluded at 94% CL



Properties of the Top Quark

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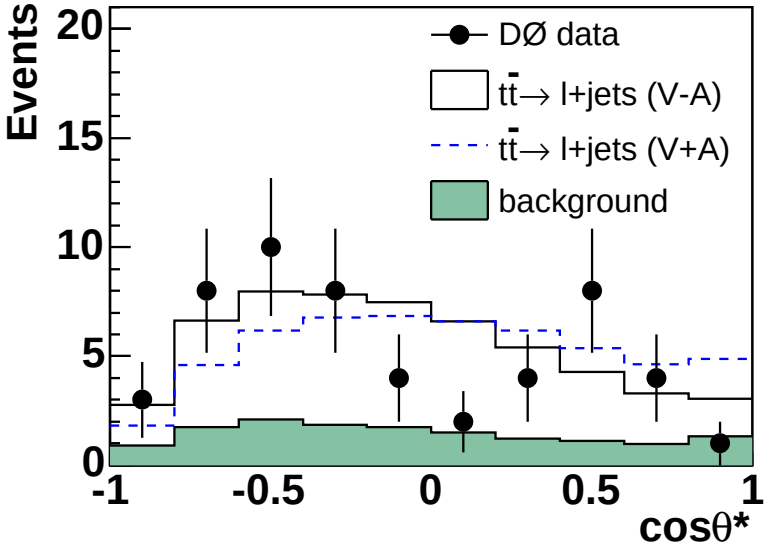
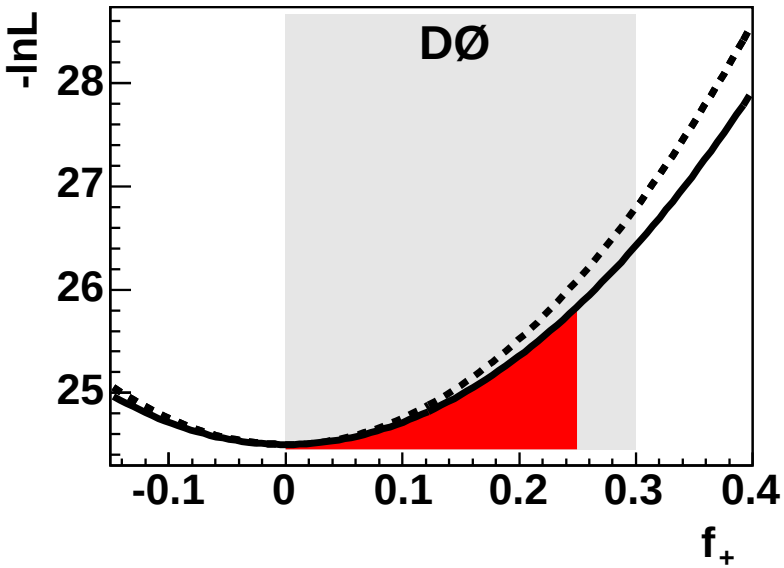
Top electroweak coupling: any hint of V+A contribution? → W-Helicity

Combined results from l+jets and dilepton channels:

$f+ = 0.04 \pm 0.11$ (stat) ± 0.06 (syst) $\rightarrow f+ < 0.25$ at 95% C.L.





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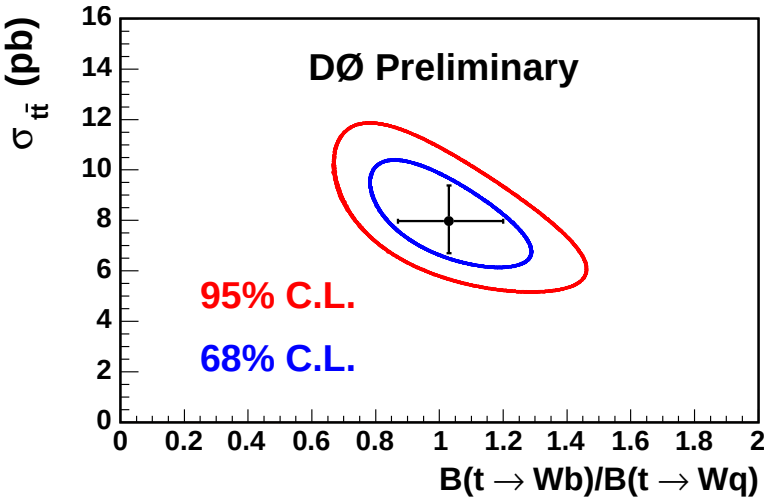
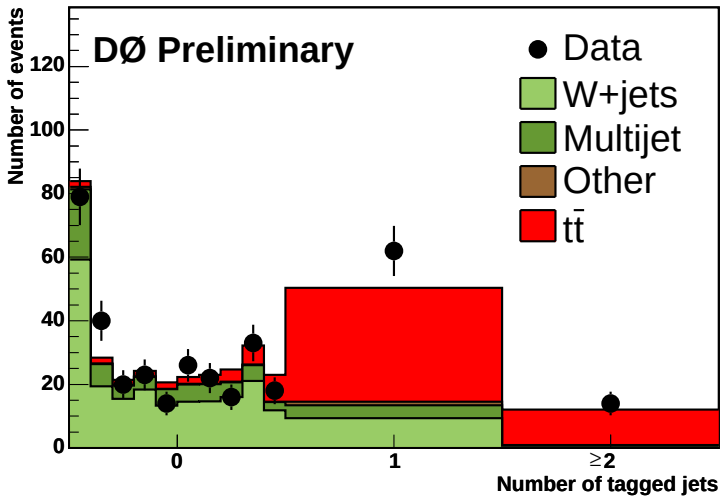
Top electroweak coupling: V_{tb} from R=BR($t \to Wb$)/BR($t \to Wq$)

Simultaneous measurement of R and $t\bar{t}$ cross section

R=$1.03^{+0.19}_{-0.17}$ → $|V_{tb}|$ >0.80 at 95% C.L.

Top Spin: measurement in progress

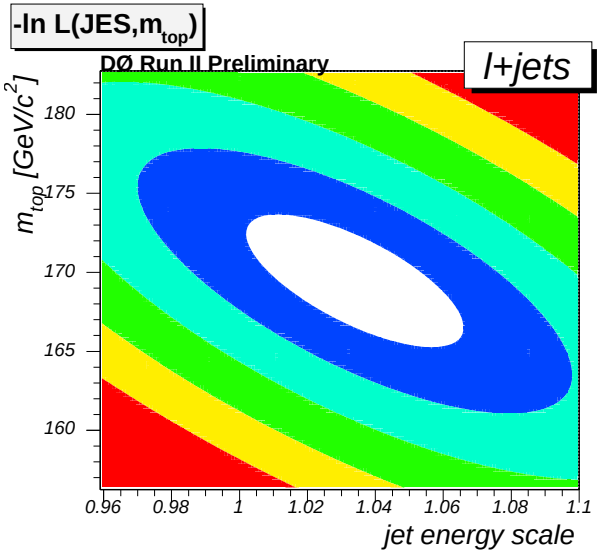


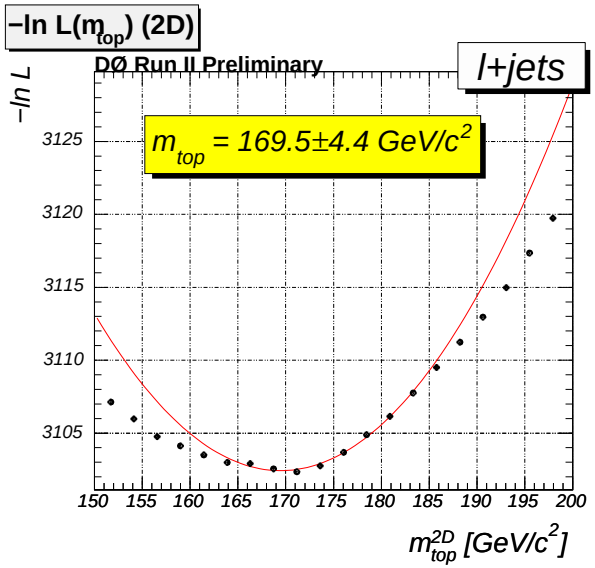


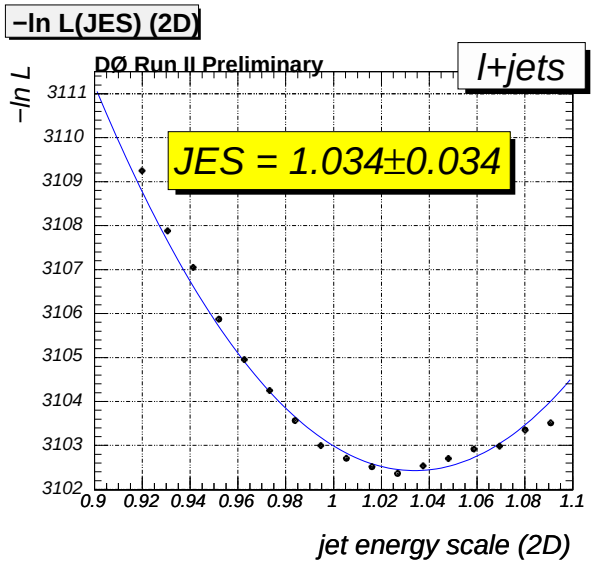
Measurement of the Top Mass

New preliminary mass measurement using matrix element technique (320 pb^{-1})

Significant improvement: in-situ calibration of jet energy scale using $W \rightarrow qq$







Result:

$$m_{top} = 169.5 \pm 4.4(\text{stat+JES}) \, ^{+1.7}_{-1.6}(\text{syst}) \text{ GeV}$$

(JES scale factor = 1.034 ± 0.034)

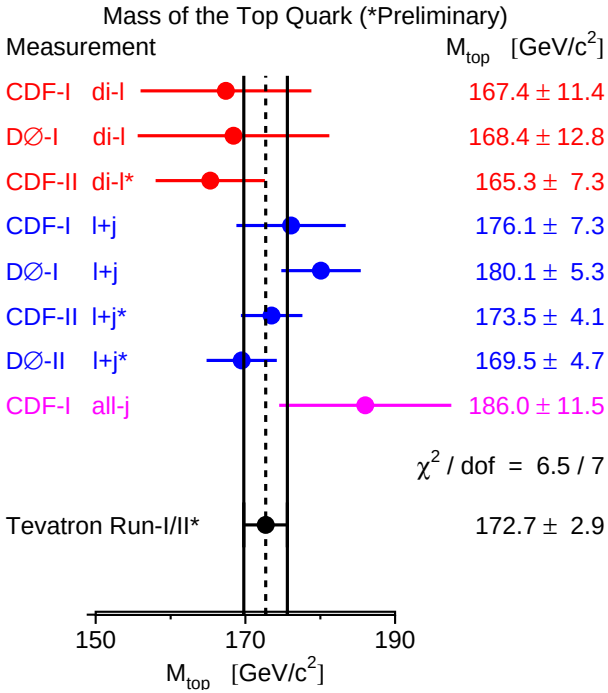
New Tevatron combination (TEVEWWG):

$$m_{top} = 172.7 \pm 1.7(\text{stat}) \pm 2.4(\text{syst}) \text{ GeV}$$

Implications for mass of SM Higgs boson:

$$M_H = 91^{+45}_{-32} \text{ GeV}$$

$$M_H < 186 \text{ GeV at 95\% C.L.}$$



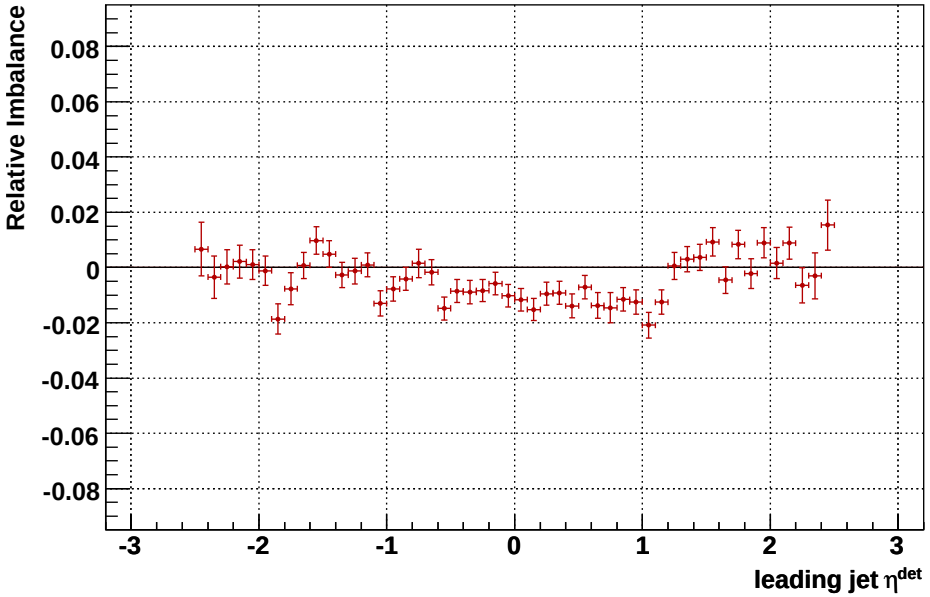
Jet Energy Scale for 1 fb^{-1} Analyses

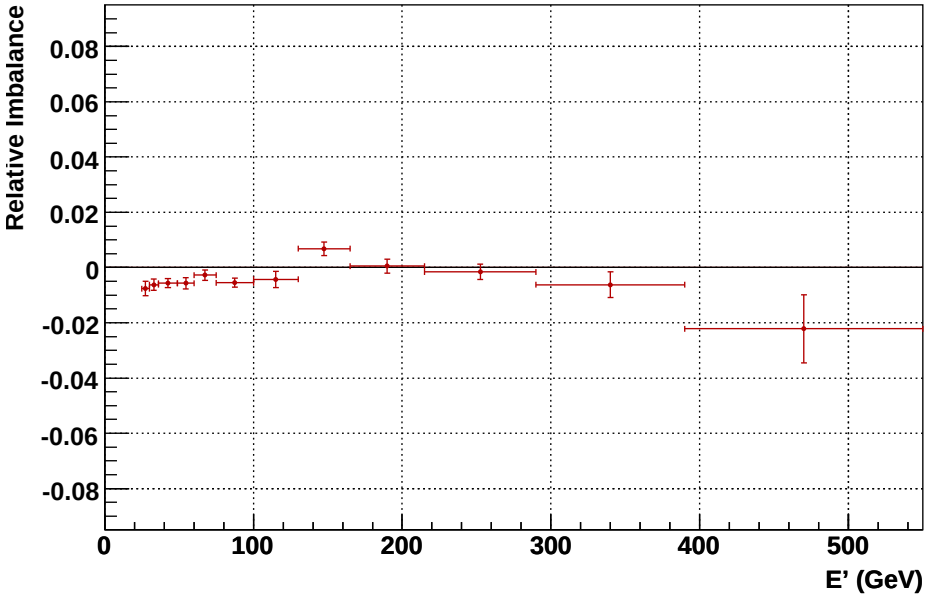
Currently finalizing improved jet energy calibration

- based on latest calorimeter calibration
- improved photon identification $\longrightarrow$ less background
- MC studies to understand possible bias from background contamination
- numerous refinements in calibration procedure

Goal: uncertainty $<$ 2.5% (for 50 GeV jets in central region)

- closure tests are within 2% (preliminary)





Focus is now shifting towards high-precision calibration of b-jets

Measurement of the Top Mass

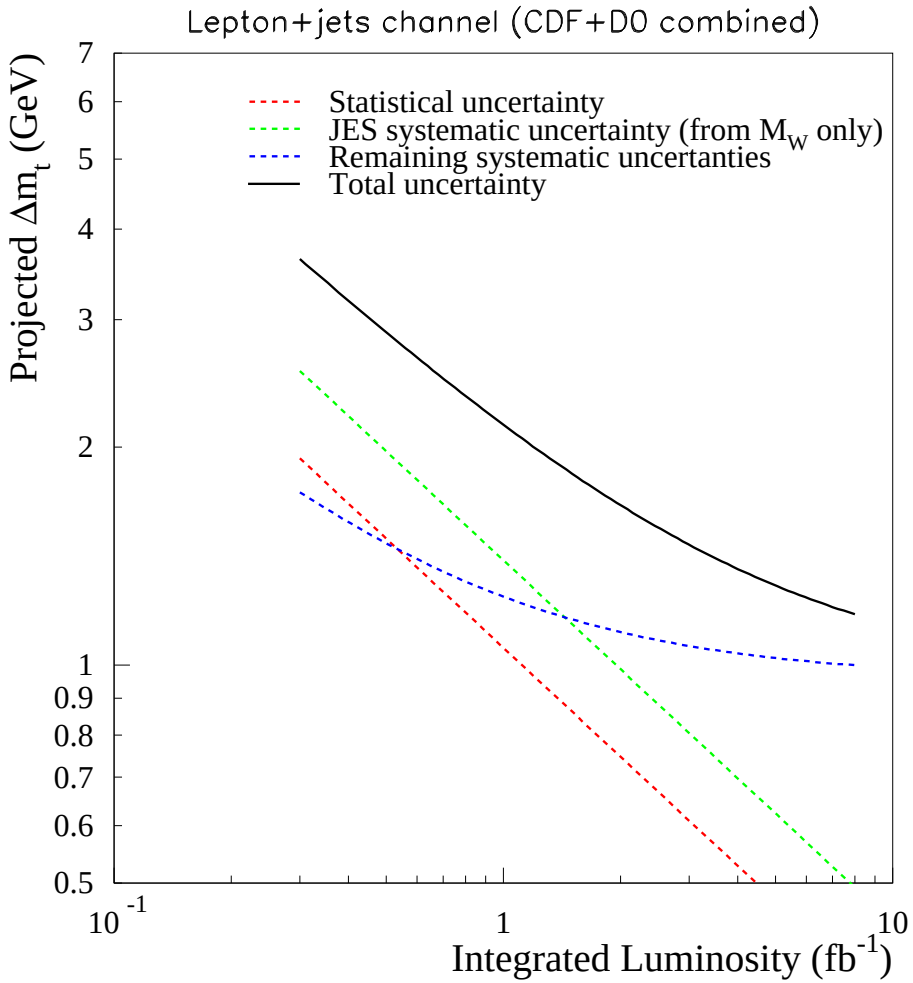
Projection of error on top mass for remainder of Run II:

- **Normalizing stat. and syst. error to current performance at 300 pb^{-1}**
- **Irreducible syst. uncertainty of ± 1.1 GeV (± 1 GeV correlated across experiments)**

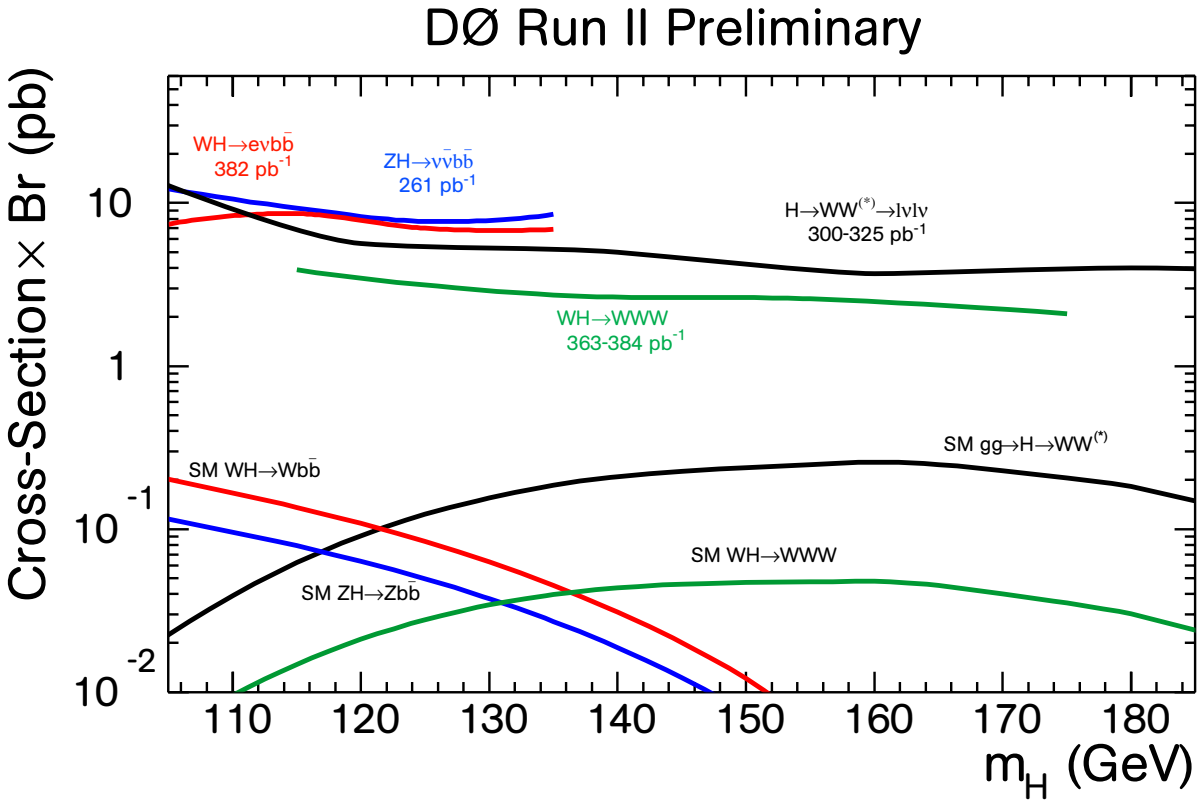
$\rightarrow$ Projected error of 1.4 (1.2) GeV with 4 fb^{-1} (8 fb^{-1})!

Projected systematic errors on m_t

Source	Error
JES p_T dependence	$\pm$ 0.35
B-jet energy scale	$\pm$ 0.7
Signal Modeling (gluon rad.)	$\pm$ 0.4
Background Modeling	$\pm$ 0.4
MC calibration	$\pm$ 0.4
Trigger	$\pm$ 0.1
PDF's	$\pm$ 0.3
Total	$\pm$ 1.1



Search for the Standard Model Higgs Boson



Recent results from DØ:

- **WH⟶WWW in like-sign dileptons (370 pb^{-1}, prel.)**
- **WH in electron channel (382 pb^{-1}, prel.)**
- **ZH⟶ $\nu\nu bb$ (261 pb^{-1}, prel.)**
- **H⟶WW (325 pb^{-1}, accepted by PRL)**

Second-generation analyses with 1 fb^{-1} dataset in progress

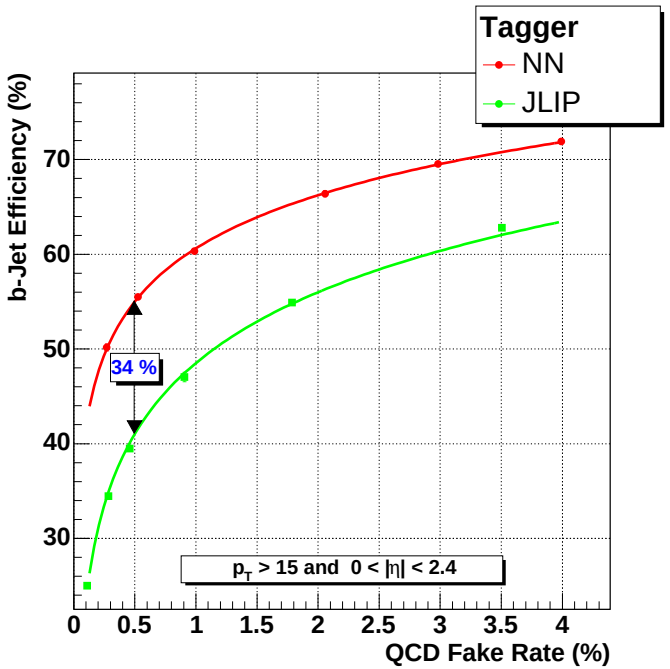
Algorithm Improvements for 1 fb^{-1} Analyses

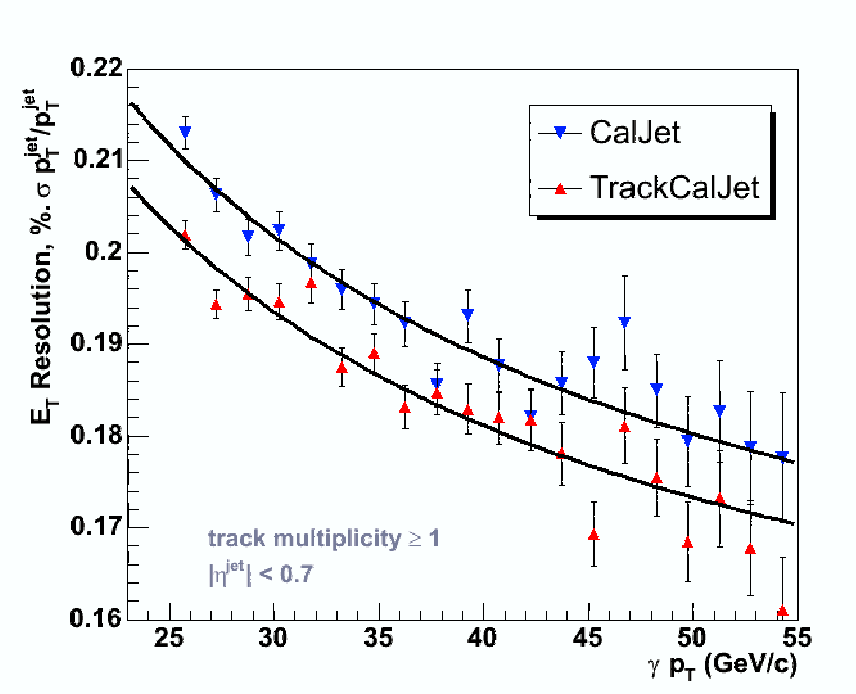
B-Tagging using neural network

- Combining information from secondary vertex and jet impact parameter tagger
- Significant Improvement: efficiency increase by 34% (at fake rate of 0.5%)
- Further improvements expected from new vertexing

Jet energy measurement using tracks

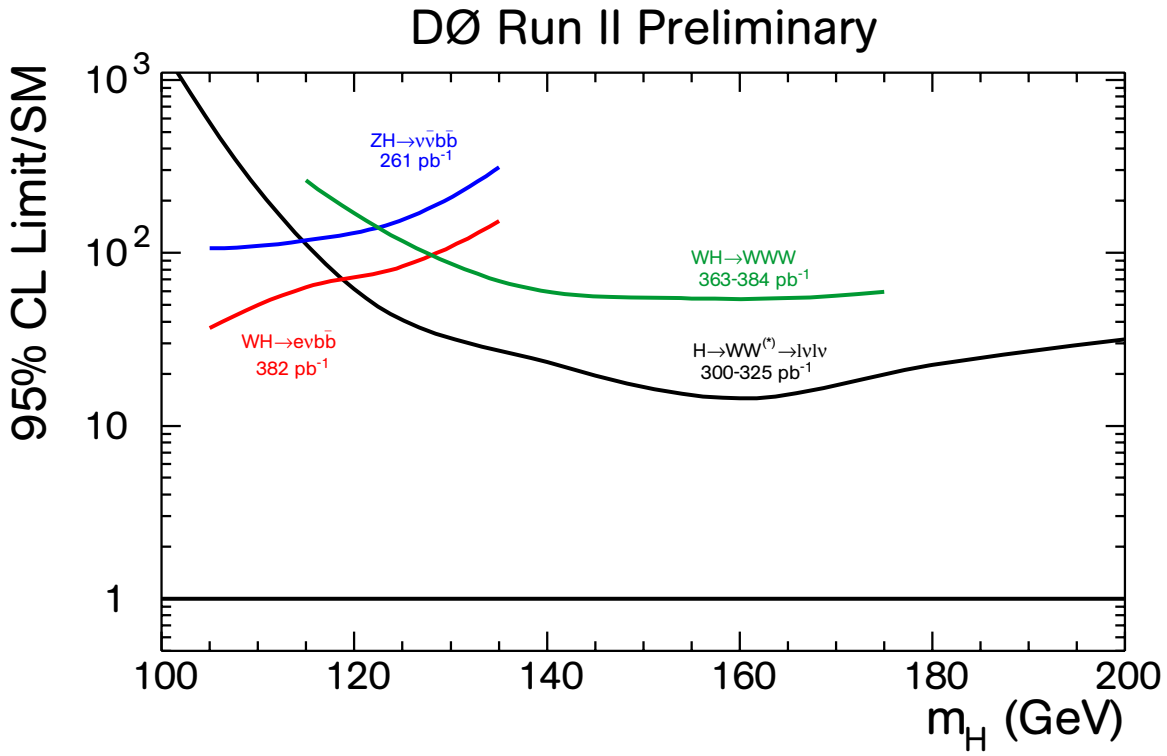
- Tracking detectors provide precise measurement of low-momentum particles
- Combining with cal. information leads to 10% improvement in jet energy resolution
- Expecting further improvements from measurement of single pion response and further tuning of the algorithm





Search for the Standard Model Higgs Boson

There is still a long way to go...



Shortcomings in current analyses understood, improvements ready and demonstrated to be sufficient for WH/ZH/H→WW:

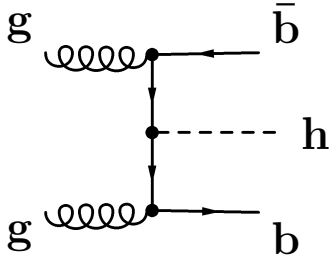
- **b-tagging: Neural-Network tagging, efficiency increase 34% per jet → factor 1.8!**
- **mass resolution: "TrackCalJets", improvement >20%**
- **missing channels and acceptance: add isolated tracks, forward leptons, ZH→ $\ell\ell bb$**
- **multivariate techniques**
- **combining channels, experiments: TEVNPHWG and procedures in place**

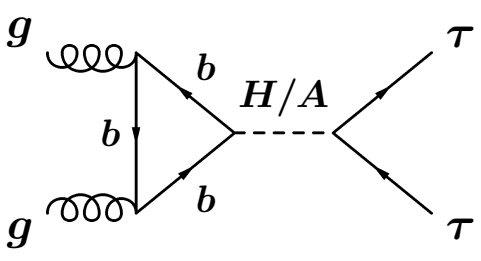
Search for SUSY Higgs Bosons

- MSSM predicts at least one light Higgs boson → ideal for searches at Tevatron
  - can use re-interpretation of SM Higgs searches
  - in addition: dedicated SUSY Higgs searches in large $\tan\beta$-region
- Large $\tan\beta$: $hb\bar{b}$-coupling enhanced

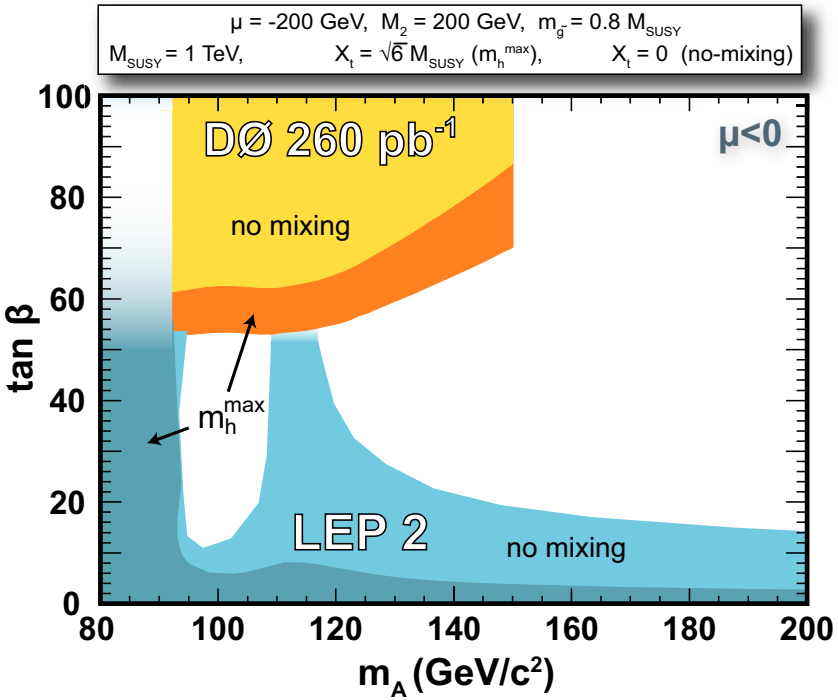
  → large cross-sections for $h(b\bar{b})$ production

  → both $h \to b\bar{b}$ and $h \to \tau\tau$ are accessible

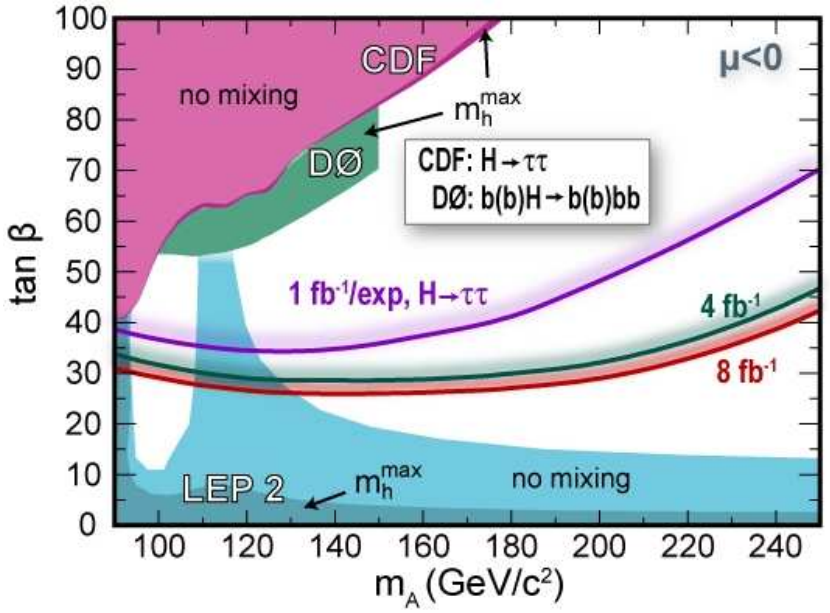




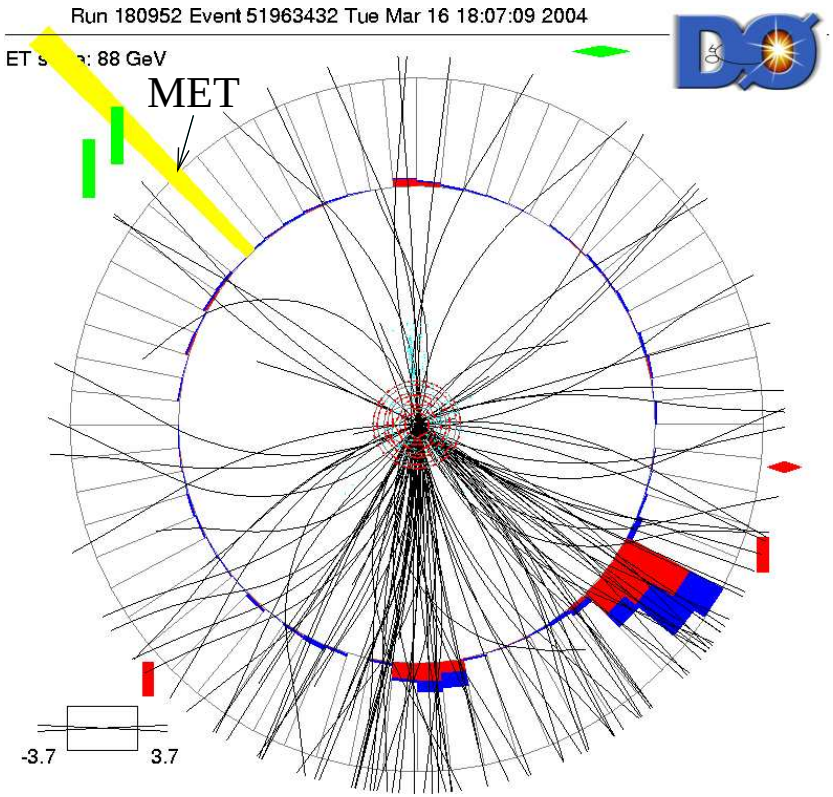
- Search for $hb(\bar{b}) \to b\bar{b}b(\bar{b})$ published (260 pb^{-1}), analyses with $h \to \tau\tau$ in progress
- Combined analyses promise significant reach in $(\tan\beta, m_A)$-plane



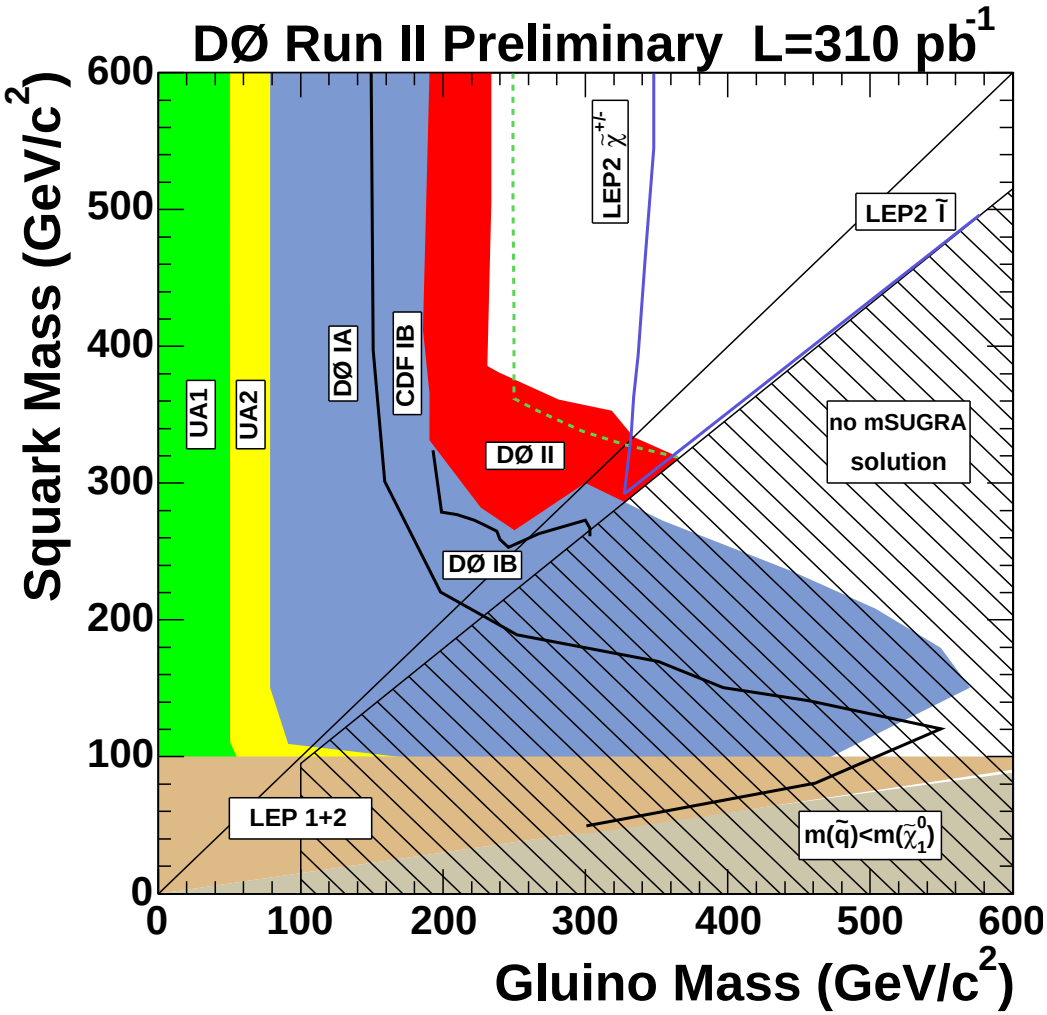
Tevatron Projection



Search for Supersymmetry – Squarks/Gluinos

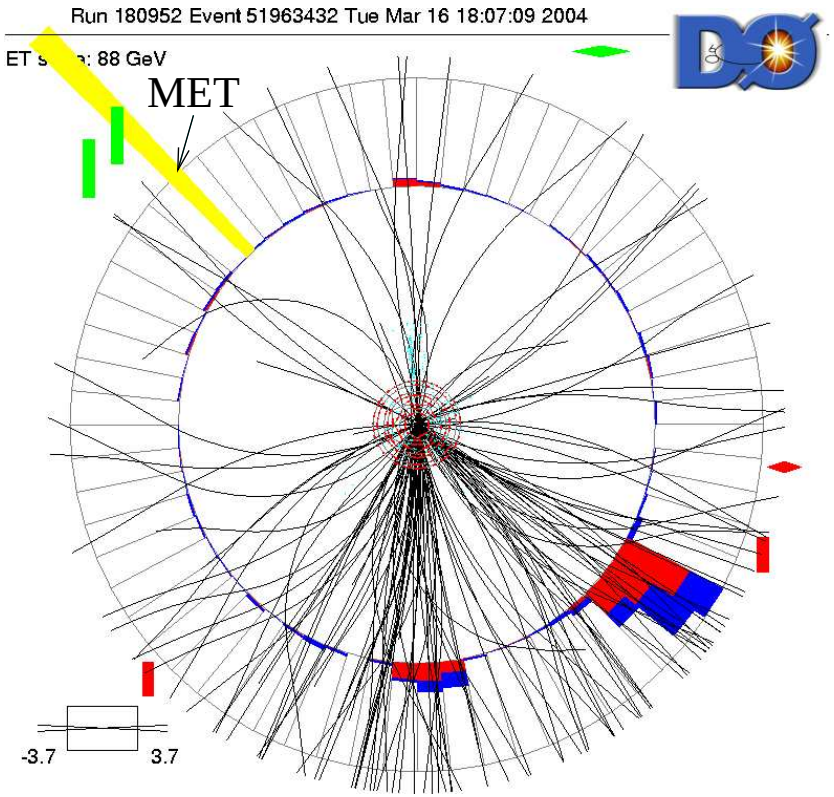


$\tilde{q}\tilde{q}$ candidate event
($\not\!\!E_T$=354 GeV, p_T^{j1}=264 GeV, p_T^{j2}=106 GeV)



- DØ search sets new limits in squark/gluino mass plane
- Have reached sensitivity beyond Run I and LEP limits
- Run IIb projection: can probe squark masses up to about 400 GeV

Search for Supersymmetry – Squarks/Gluinos



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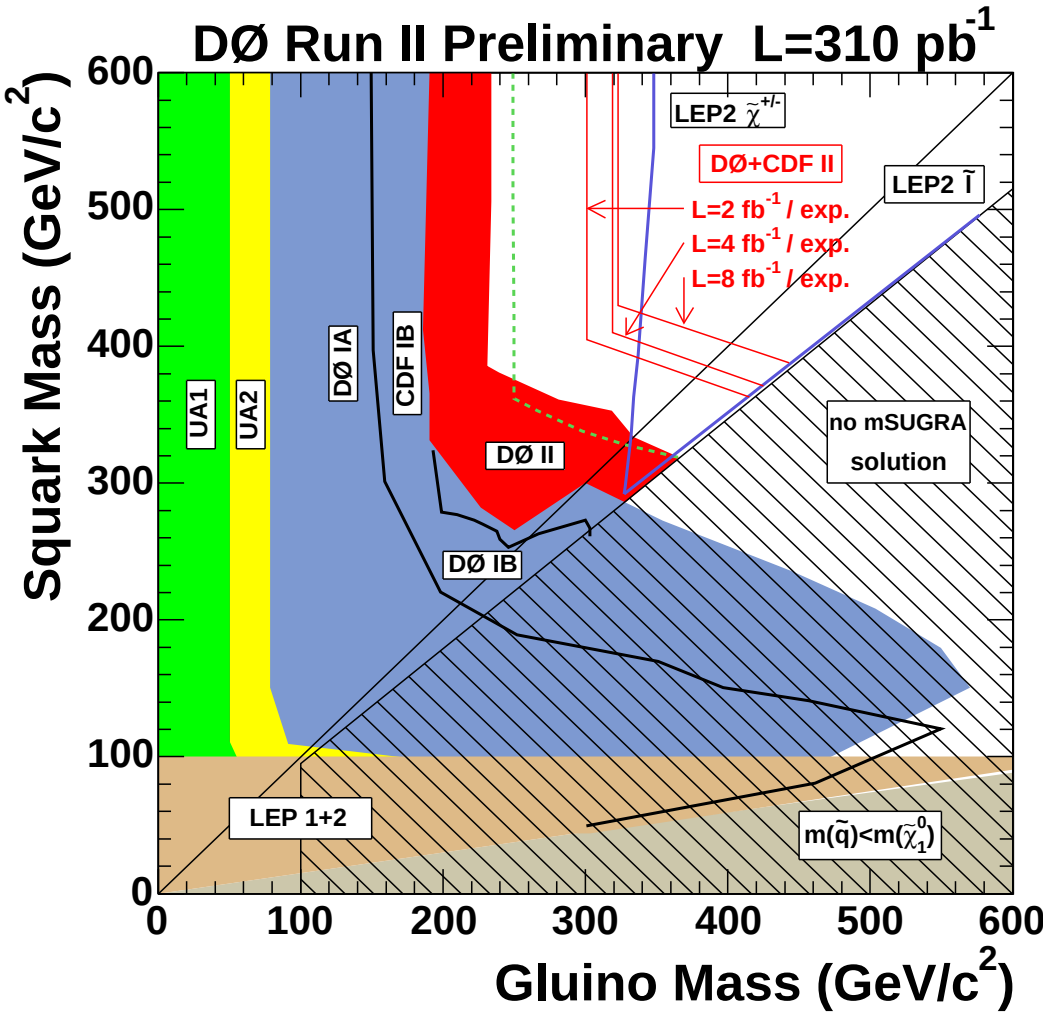


- DØ search sets new limits in squark/gluino mass plane
- Have reached sensitivity beyond Run I and LEP limits
- Run IIb projection: can probe squark masses up to about 400 GeV

Search for Charginos and Neutralinos

- Production cross section (electroweak) relatively small

  → need clean leptonic signature to suppress backgrounds

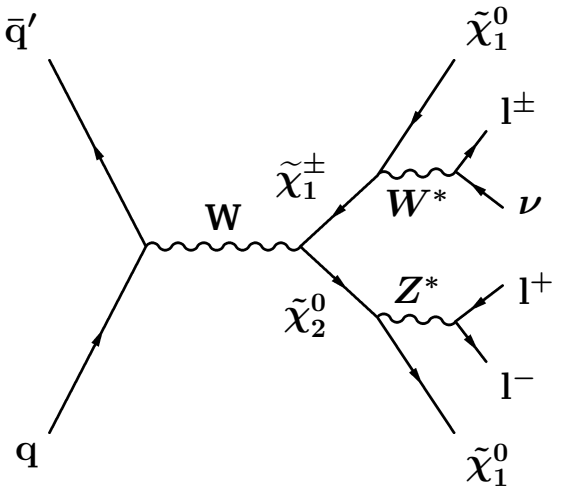
- Golden channel: $\tilde{\chi}^{\pm}\tilde{\chi}^{0}_{2} \rightarrow 3\ell + \not{E}_T$

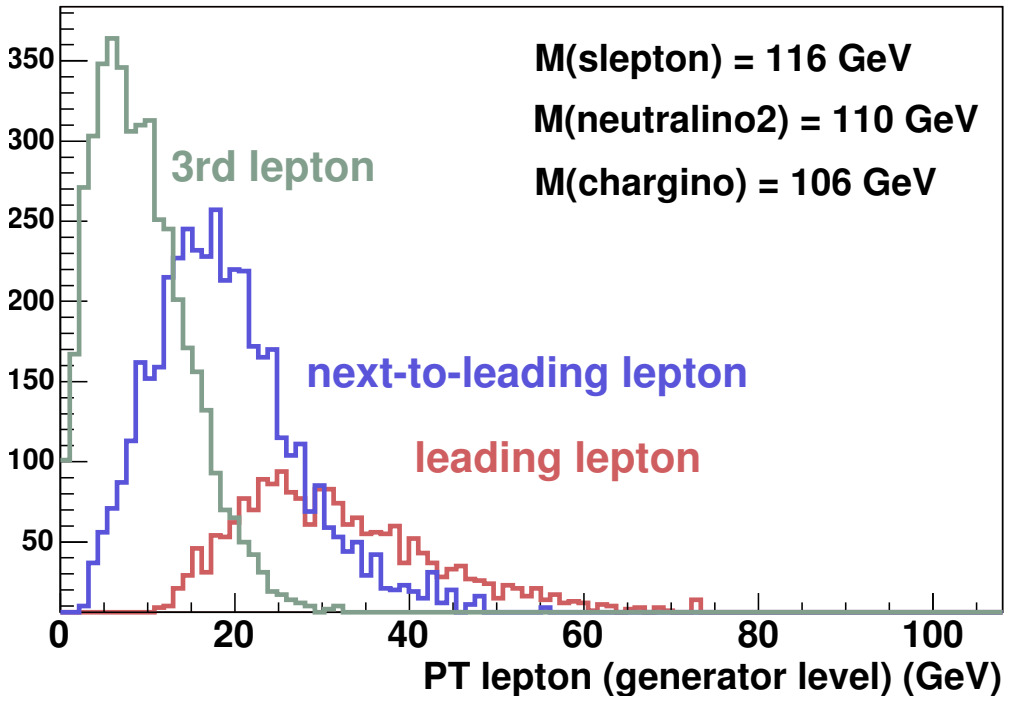
- Experimental Challenge: low-p_T leptons

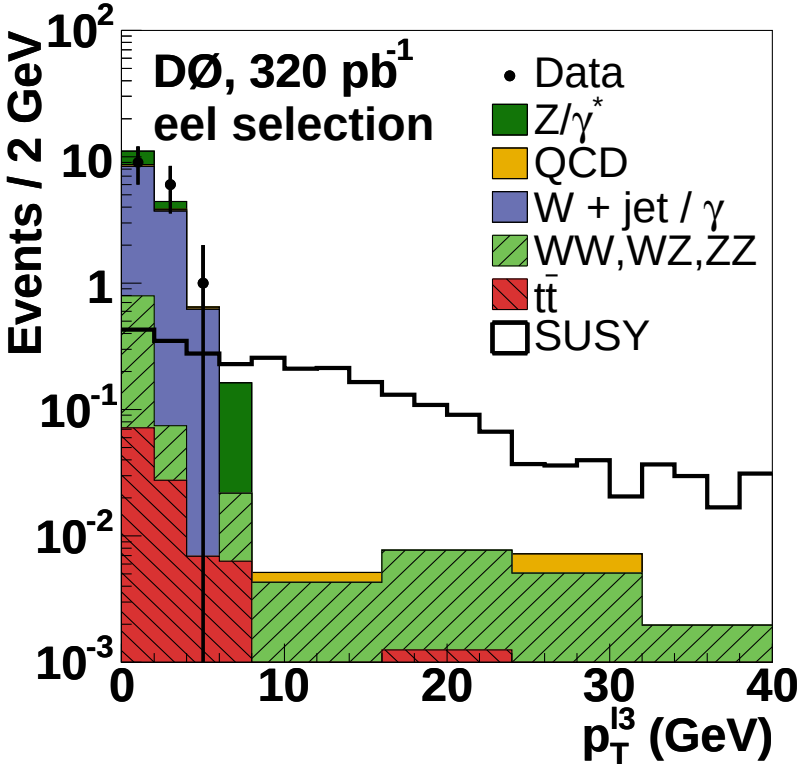
  → need multilepton triggers with low thresholds

  → need efficient lepton identification at low p_T

- Analysis Strategy:
  - two identified leptons (e, μ, τ) plus isolated track

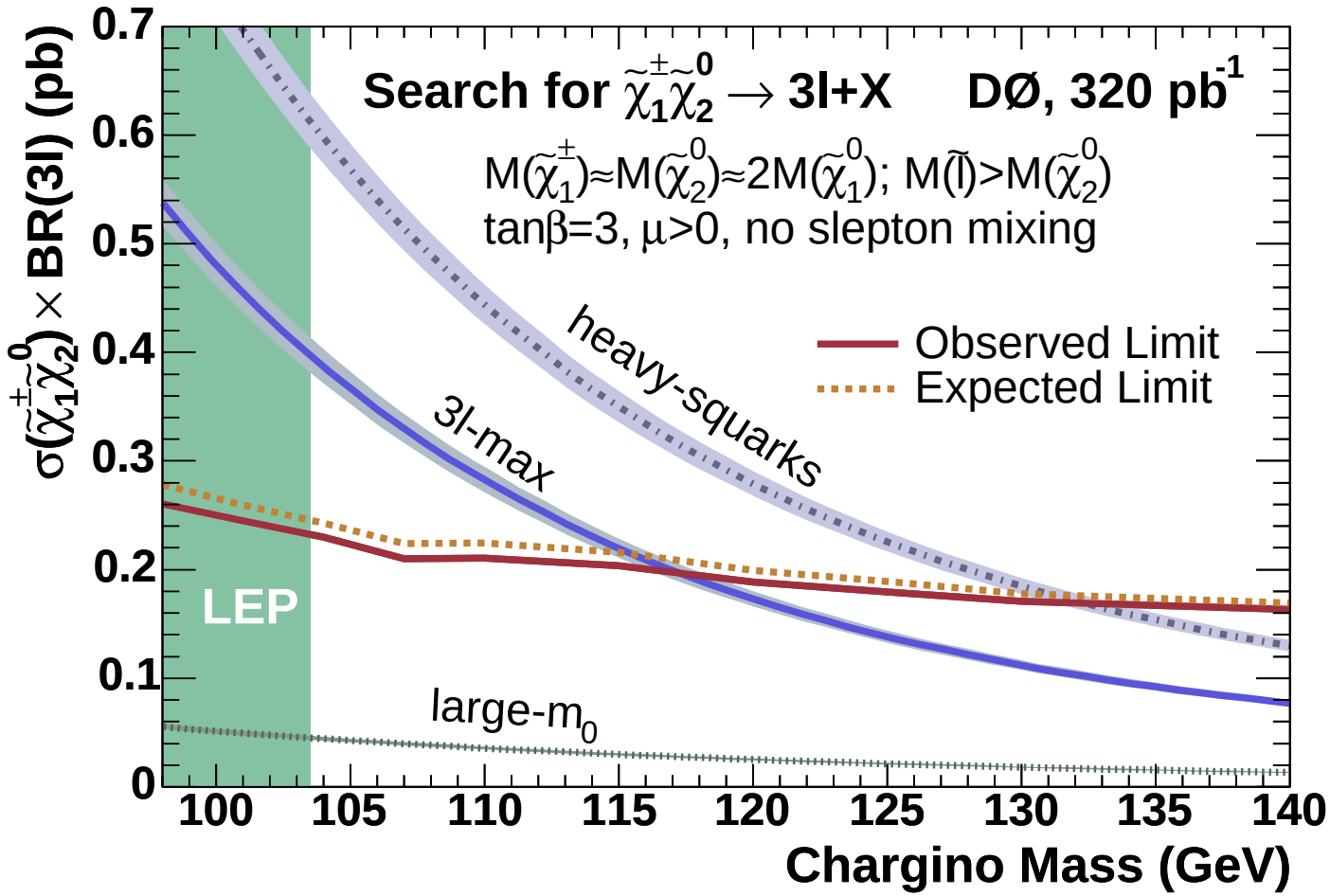






Search for Charginos and Neutralinos

Selection	Exp. Backgr.	Data
$ee\ell$	0.21±0.12	0
$e\mu\ell$	0.31±0.13	0
$\mu\mu\ell$	1.75±0.57	2
ls-$\mu\mu$	0.66±0.37	1
$e\tau\ell$	0.58±0.14	0
$\mu\tau\ell$	0.36±0.13	1
Combined	3.87±0.81	4

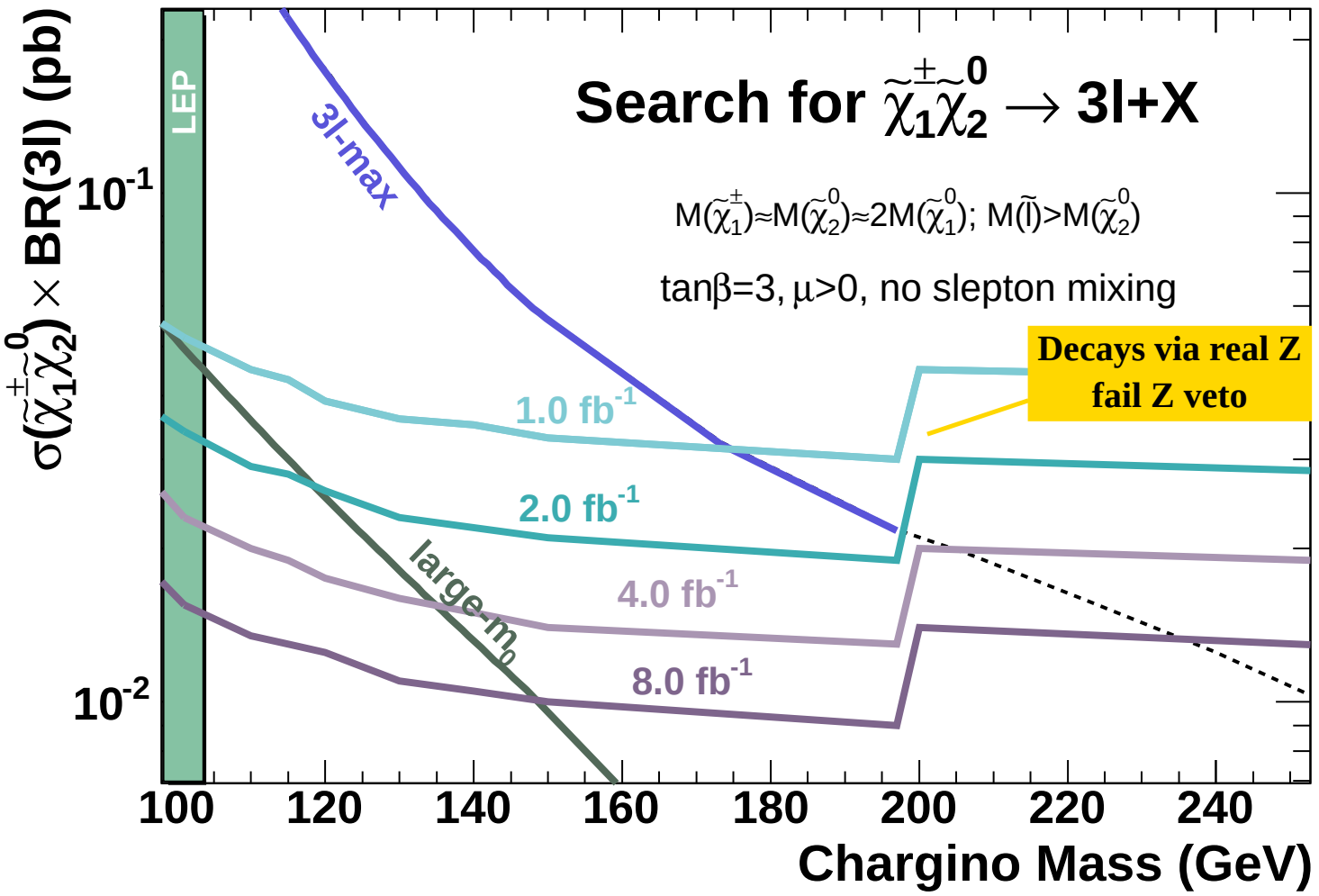


Published analysis constrains SUSY beyond LEP chargino limits:

- **3ℓ-max scenario: $m_{\tilde{\chi}^{\pm}} > 117$ GeV**
- **heavy-squarks scenario: $m_{\tilde{\chi}^{\pm}} > 132$ GeV**

High $\tan\beta$-region very challenging

Search for Charginos and Neutralinos



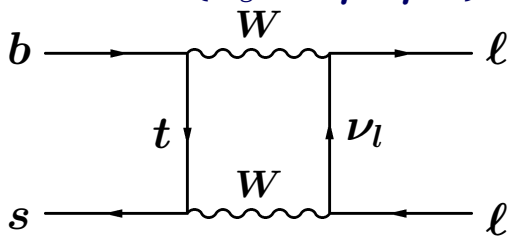
Run IIb projections (assuming some analysis improvements):

- **3ℓ-max scenario: will probe $m_{\tilde{\chi}^{\pm}} > 200$ GeV**
- **large-m_0 scenario: sensitive up to $m_{\tilde{\chi}^{\pm}} \approx 150$ GeV**

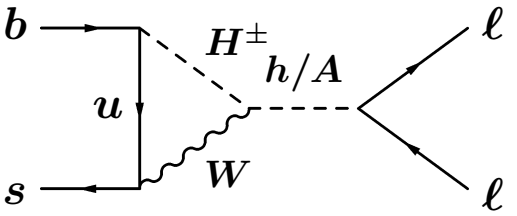
High $\tan\beta$-region very challenging

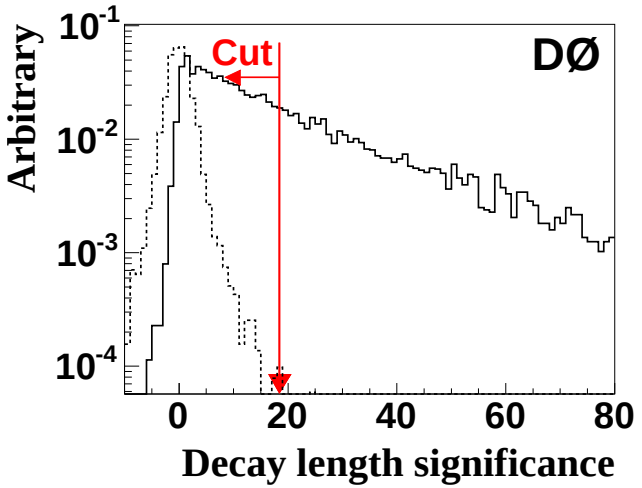
Supersymmetry and $B_s \to \mu^+\mu^-$

SM prediction: BR($B_s \to \mu^+\mu^-$)=3.8×10^{-9}



SUGRA: enhancement $\sim (\tan\beta)^6$



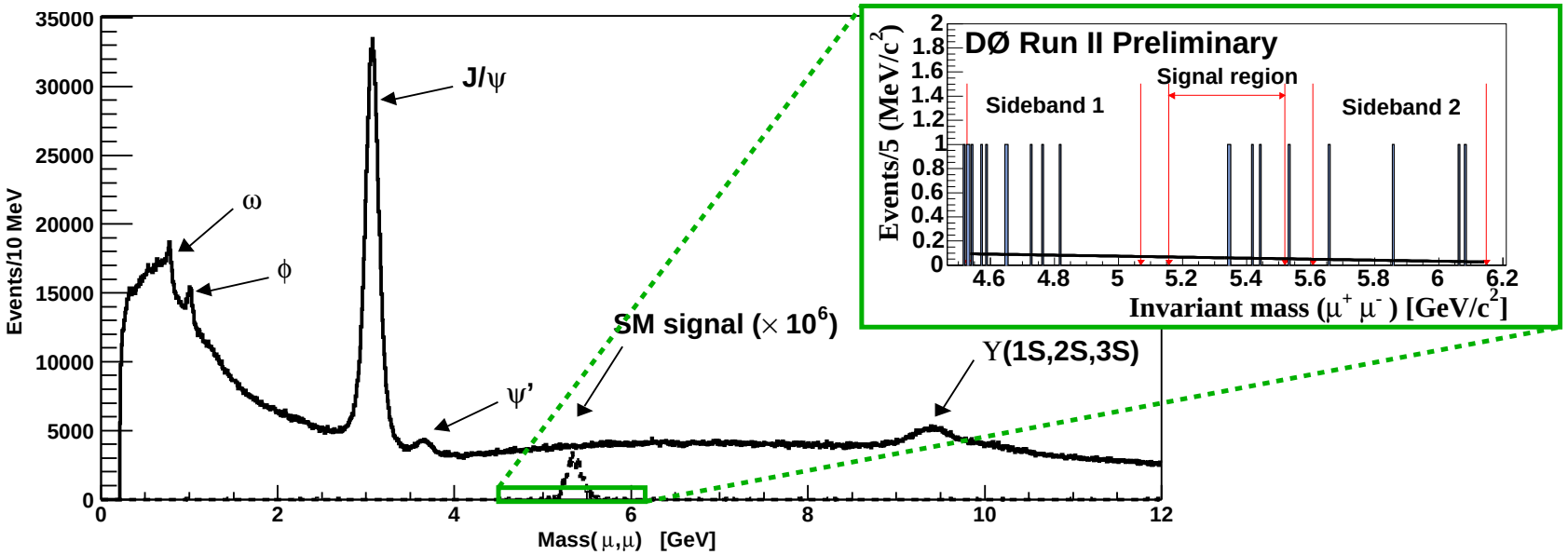


→ significant at high $\tan\beta$: BR=$O(10^{-7})$

→ complementary to trilepton search

– Tevatron: large production rate for B_s

– Selection: two isolated muons, displaced vertex



Supersymmetry and $B_s \to \mu^+\mu^-$

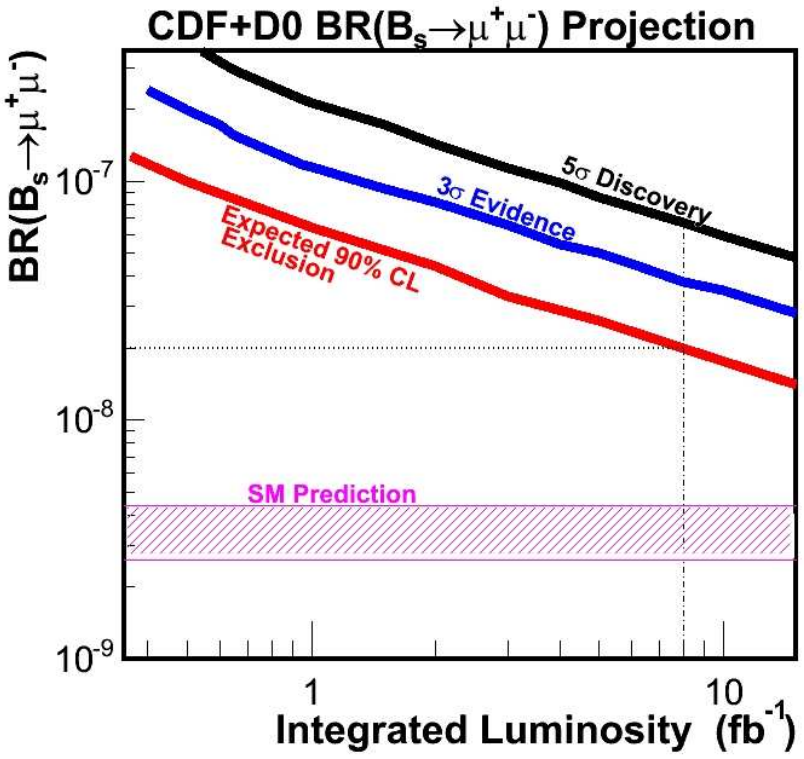
Results (limits at 95% C.L.):

DØ	(300 pb^{-1}):	4.3±1.2 expected, 4 observed →	BR($B_s \to \mu^+\mu^-$)<3.7×10^{-7}
CDF	(364 pb^{-1}):	1.5±0.2 expected, 0 observed →	BR($B_s \to \mu^+\mu^-$)<2.0×10^{-7}
		TEVNPHWG Combination:	BR($B_s \to \mu^+\mu^-$)<1.5×10^{-7}

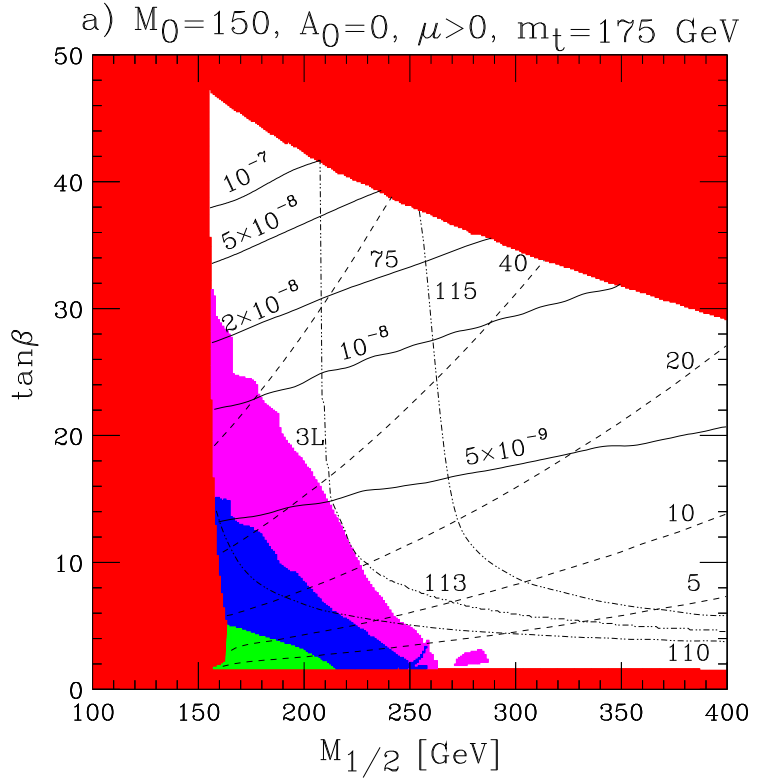
DØ result will be updated with 1 fb^{-1} by Moriond

Projection for Run IIb: sensitivity will approach 10^{-8}

→ **will test large part of SUGRA parameter space**



Dedes, Dreiner, Nierste, Richardson (hep-ph/0207026)



Conclusions

- Detector operating very well, close to 1.1 fb^{-1} accumulated so far
- Long-term planning to maintain efficient operation while LHC is ramping up
- Run IIb Layer 0 and trigger upgrades ready to install
  - currently integrating parallel slices into operations
  - expect a 14-week shutdown no later than March 1, 2006
- Calibration/Reconstruction/Simulation mature
- Reprocessing completed, 1 fb^{-1} dataset being analyzed
- Wealth of physics results, 30 publications within one year
- Potential for measurements/discoveries that will advance the field in several key areas

δM_t = 1.2 GeV,
δM_W = 24 MeV, world avg
(LEP2 + δM_W = 30 MeV(Tevatron), no LEP/TeV correlations)